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# Marine Fisheries REVIEW

National Oceanic and Atmospheric Administration • National Marine Fisheries Service

## The Soviet Fishing Fleet

SPECIAL: Full text of Stevenson Caracas statement

U.S. DEPARTMENT OF COMMERCE
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# Marine Fisheries Review

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**Cover—A Russian vessel, the SRTM *Matros*, fishes for Alaska pollock in the eastern Bering Sea. NMFS photo.**

# An Address Before the Plenary Session of the Law of the Sea Conference

BY AMBASSADOR JOHN R. STEVENSON

Mr. President, Distinguished Representatives: first of all, I want to express on behalf of my Delegation our sincere thanks to the Venezuelan Government for the splendid arrangements it made for the Conference and for us. It is truly a miracle that since the invitation was extended by Venezuela and accepted by the General Assembly of the United Nations in December, all the preparations should have been carried out so efficiently, with such careful attention to our needs and our comfort.

**Three Auguries of a Successful Conference.** Mr. President, the practical and favorable working conditions which the Venezuelan Government has so graciously provided are the first of three auguries of a most successful conference. The other two are the adoption on schedule by consensus of the rules of procedure, and second, the constructive, moderate tone and the developing consensus on substance reflected in the statements given in the last two weeks.

Stevenson

**Adoption of Rules of Procedure.** The adoption of the rules of procedure on schedule by consensus was significant because these rules are a reasonable accommodation between those who wished to avoid premature voting and those who were concerned because it showed what inspired, firm and sensitive leadership,

**"We must not let this opportunity pass."**

as provided by you, sir, can do in reconciling differences and leading us to a generally acceptable result. You have set a high standard for our committee chairmen, but knowing and respecting all of them as I do, I am convinced that the team of Engo, Aguilar, Yankov and Beesley will live up to this challenge. The conference has selected its leadership with care and with great wisdom.

**Moderate and Constructive Tone of General Debate.** Our delegation has noted with a growing sense of appreciation and optimism for the future, the generally moderate, constructive tone of the statements made in the course of the last two weeks. Only very few delegations have departed from this general pattern, misrepresenting past events and the present positions of some delegations, including our own.

We are not here to engage in mutual recriminations. We must roll up our sleeves and get down to the practical business of drawing up a generally acceptable constitution for the oceans before disputes over conflicting uses of the same ocean space and unilateral action by individual states put such agreement out of our reach.

**Growing Consensus on Limits of National and International Jurisdiction.** In the course of listening to and reading the statements made during the last two weeks, I have been struck by the very large measure of agreement on the general outlines of an overall settlement. Most delegations that have spoken have endorsed or indicated a willingness to accept, under certain conditions and as part of a package settlement, a maximum limit of 12 miles for the territorial sea and of 200 miles for an economic zone, and an international regime for the deep seabed in the area beyond national jurisdiction.

The United States has for a number of years indicated its flexibility on the limits of coastal state resources jurisdiction. We have stressed that the content of the legal regime within such coastal state jurisdiction is more important than the limits of such jurisdiction. Accordingly, we are prepared to accept, and indeed we would welcome general agreement on a 12-mile outer limit for the territorial sea and a 200-mile outer limit for the economic zone provided it is part of an acceptable, comprehensive package including a satisfactory regime within and beyond the economic zone and provision for unimpeded transit of straits used for international navigation. Coastal state economic jurisdiction beyond 200 miles with which

**EDITORIAL NOTE**

The Third United Nations Law of the Sea Conference (LOS), a 10-week session held in Caracas, Venezuela this summer, will without doubt have a deep and lasting impact on the world's marine resources. Because of its unprecedented importance, *Marine Fisheries Review* is printing, in its entirety, the address delivered by Ambassador John R. Stevenson, Special Representative of the President and U.S. Representative to the Law of the Sea Conference, before the Plenary Session on 11 July 1974.

**"In the case of fisheries . . .**

**". . . coastal state management and preferential rights over coastal and anadromous species would be recognized.**

**". . . The principle of full utilization will ensure that renewable resources which might not otherwise be utilized will give some economic benefit to the coastal state and help meet the international community's protein requirements.**

**". . . Agreed international conservation and allocation standards for the rational management of tuna should in the long run benefit coastal states which seek to engage in fishing these species and would maintain the populations of the tuna that migrate through their zone.**

**". . . most states are prepared to agree to coastal state enforcement jurisdiction with respect to resource exploitation within the economic zone."**

the Conference must deal: jurisdiction over the resources of the continental margin when it extends beyond 200 miles and jurisdiction over anadromous fish such as salmon, which originate in coastal rivers but swim far out into the ocean before returning to the stream of their birth to spawn and die.

A number of states have expressed the view that under the continental shelf convention and the continental shelf doctrine of customary international law as interpreted by the International Court of Justice, they have rights over the resources of the continental margin and that they will not accept any Law of the Sea treaty which cuts off the rights at 200 miles.

Other states are reluctant to reduce the common heritage of mankind by recognizing coastal state jurisdiction beyond 200 miles. Still others, including the United States, have suggested an approach which gives coastal states the limit they seek, but provides, through uniform payments of a percentage of the value of production, for the sharing by other states in the benefits of the exploitation of the non-renewable resources in part of the area. This would seem to be an equitable basis for an accommodation.

With respect to salmon, the views of my country are well known. This species of fish depends for survival on the maintenance at considerable economic cost of a favorable environment in coastal rivers and streams, and can effectively be conserved and managed only if caught when returning to the fresh waters of its origin,

**"The very survival of this species of fish (salmon) may depend on the action we collectively take at this conference."**

in the internal waters, territorial sea or economic zone of the host state. The very survival of this species of fish may depend on the action we collectively take at this conference.

**Consensus on limits of national and international jurisdiction is conditional on the nature of coastal and international regimes within these limits.** The statements to date make clear that in the case of a large number of states whose agreement is critical for an effective, generally acceptable treaty, the growing consensus on the limits of national jurisdiction, i.e. a maximum outer limit of 12 miles for the territorial sea and of 200 miles for the economic zone, is conditional on a satisfactory overall treaty package and, more specifically, on provisions for unimpeded transit of international straits and a balance between coastal state rights and duties within the economic zone.

**Territorial Sea.** With respect to the coastal states' right to establish a territorial sea of up to a maximum of 12 miles, it is the view of many delegations, including our own, that general recognition of this right must be accompanied by treaty provisions for unimpeded passage through, over, and under straits used for international navigation. The formulation of treaty language which will maintain a nondiscriminatory right of unimpeded transit while meeting coastal state concerns with respect to navigational safety, pollution, and security will be one of the second committee's most important tasks.

**Economic Zone.** Our willingness and that of many other delegations to accept a 200-mile outer limit for the economic zone depends on the concurrent negotiation and acceptance of correlative coastal state duties.

The coastal state rights we contemplate comprise full regulatory jurisdiction over exploration and exploitation of seabed resources, non-resource drilling, fishing for coastal and anadromous species, and installations constructed for economic purposes.

The rights of other states include freedom of navigation, overflight, and other non-resource uses.

With respect to the zone as a whole, we contemplate coastal state duties to prevent unjustifiable interference with navigation, overflight, and other non-resource uses, and to respect international environmental obligations. With regard to the seabeds and economic installations, this includes respect for international standards to prevent interference with other uses and to prevent pollution. With regard to fishing, this includes a duty to conserve living resources.

For the seabeds, we also contemplate a coastal state duty to observe exploration and exploitation arrangements it enters into.

For fisheries, to the extent that the coastal state does not fully utilize a fishery resource, we contemplate a coastal state duty to permit foreign fishing under reasonable coastal state regulations. These regulations would include conservation measures and provision for harvesting by coastal state vessels up to their capacity and

could include the payment of a reasonable license fee by foreign fishermen. We also contemplate a duty for the coastal state and all other fishing states to cooperate with each other in formulating equitable international and regional conservation and allocation regulations for highly migratory species, taking into account the unique migratory pattern of these species within and without the zones.

The negotiation and elaboration of these duties is a critical responsibility of the second committee.

With respect to the related assertions by a number of states of coastal state plenary jurisdiction over scientific research and vessel-source pollution throughout the economic zone, the statements made clear that the willingness of many delegations, including my own, to negotiate on the basis of conditional acceptance of a 200-mile economic zone does not include acceptance of a requirement of coastal state consent for scientific research and coastal state control over vessel-source pollution within the zone.

For our part, we believe that, as an alternative to coastal state consent, a series of obligations should be imposed on the researcher and his flag state to respect coastal state resource interests in the zone. The obligations would include advance notification, participation, data sharing, assistance in scientific research technology and in interpretation of data, and compliance with applicable international environmental standards.

Vessel-source pollution presents a troublesome problem to the entire international community, including coastal states. At the same time, interference with freedom of navigation must be prevented. We believe international standards enforced by flag and port states, with provision for specific additional coastal state enforcement rights, can accommodate these legitimate interests. In this connection, we believe the coastal state may be authorized to take enforcement action in emergencies to prevent imminent danger of major harmful damage to its coast, or pursuant to a finding in dispute settlement that a flag state has unreasonably and persistently failed to enforce applicable international standards on its flag vessels. Of course, flag and port states would retain their right to set higher standards.

While important differences in our positions remain to be resolved in this session, we are heartened as we embark in these negotiations by the realization that most states want to ensure both effective prevention of vessel-source pollution and protection of navigational freedoms.

We hope that the third committee can make major progress in producing agreed articles on these scientific research and pollution questions.

**International Seabed Regime Beyond National Jurisdiction.** Just as coastal states rights within the zone must, if we are to reach agreement, be balanced by duties, the international authority's jurisdiction over the exploitation of the deep seabed's resources—the common heritage of mankind—must be balanced by duties that protect the rights of individual states and their nationals—most critically in our view their right to nondiscriminatory access under reasonable conditions to the seabed's resources on a basis that provides for the sharing of the benefits of their exploitation with other states.

The statements made do indicate that there are substantial differences among us in our interpretation and proposed implementation of the common heritage principle. Both developing and developed countries have many aspirations concerning the common heritage; in some cases these are in harmony and in others they are not. My delegation believes that on a variety of issues which seem on the surface to present a wide gulf we are closer together than we think. Let us employ every possible method of work to ensure that we find these points of harmony and proceed at once to reflect this harmony in draft articles. This we believe is the principal task before the first committee at this session.

**Interest of Landlocked and Geographically Disadvantaged States.** Most prior speakers have referred to the desirability, indeed the necessity, of providing special benefits in a comprehensive Law of the Sea treaty for the landlocked and geographically disadvantaged states. The most widely supported proposals are that landlocked states' right of access to the sea and special rights in the fisheries of adjacent coastal states be recognized.

Although these recommendations do not directly affect the United States, we applaud coastal states' willingness to provide these benefits as part of an overall equitable and widely acceptable settlement and, we will, of course, support such provisions.

Much more controversial is the proposal of some landlocked and other geographically disadvantaged states that they participate in the benefits of the exploitation of nonrenewable resources—principally petroleum and natural gas—of the continental margin, either through a direct right of access to neighboring coastal states' continental margins or by the establishment of limits of coastal state jurisdiction that will keep some of the continental margin outside of coastal state control and within the common heritage.

It is my delegation's view that, as

**". . . we would welcome general agreement on a 12-mile outer limit for the territorial sea and a 200-mile outer limit for the economic zone provided it is part of an acceptable, comprehensive package including a satisfactory regime within and beyond the economic zone and provision for unimpeded transit of straits used for international navigation."**

part of a satisfactory and widely acceptable treaty, an equitable and perhaps the most practical accommodation in this area may well be to provide for coastal states' exclusive rights in the continental margin, but also to provide for international payments from mineral resources at a modest and uniform rate in the area beyond 12 miles or the 200 meter isobath, whichever is further seaward. These payments would be used primarily for developing countries, including developing landlocked and other geographically disadvantaged states. Landlocked and other geographically disadvantaged states should not expect that sharing in the benefits from deep seabed hard minerals alone could make a significant contribution to their economies.

**Compulsory Dispute Settlement.** Mr. President, my government believes that any Law of the Sea treaty is almost as easily susceptible of unreasonable unilateral interpretation as are the principles of customary international law. This is particularly true when we consider that the essential balance of critical portions of the treaty, such as the economic zone, must rest upon impartial interpretation of treaty provisions. One of the primary motivations of my government in supporting the negotiation of a new Law of the Sea treaty is that of making an enduring contribution to a new structure for peaceful relations among states. Accordingly, we must reiterate our view that a system of peaceful and compulsory third-party settlement of disputes is in the end perhaps the most significant justification for the accommodations we are all being asked to make.

**Objectives for the Caracas Session.** It is the view of my delegation that the conference should strive to adopt an entire treaty text this summer. What is required to do so is not so much technical drafting as the political will to decide a relatively small number of critical issues. Once these decisions are made, the number of treaty articles required to implement them for the territorial sea, straits, and the economic zone would not be large. The deep seabed regime will require more articles, and the first committee should concentrate on the preparation of agreed articles whenever this is possible.

What an electrifying and heartening development it would be for the international community, and what a deserved tribute to our Latin American host, if we could adopt an agreed text this session!

**"For fisheries, to the extent that the coastal state does not fully utilize a fishery resource, we contemplate a coastal state duty to permit foreign fishing under reasonable coastal state regulations. . . We also contemplate a duty for the coastal state and all other fishing states to cooperate with each other in formulating equitable international and regional conservation and allocation regulations for highly migratory species, taking into account the unique migratory pattern of these species within and without the zones."**

If we do not at least try to reach agreement on the treaty this summer, we may well not even achieve the basic minimum required to finish next year and in the interim prevent further unilateral action prejudicial to the success of the conference.

The minimum objective for Caracas, as we see it, is to complete treaty texts on most, if not all, of the critical articles—the territorial sea, straits, the economic zone, the seabed regime and the authority's functions, pollution from ocean uses, and scientific research. To achieve this objective, it is critical to recognize now that neither a statement of general principles, nor articles which define the rights of coastal states and of the seabed authority without defining their corresponding duties, would be satisfactory, or indeed at all acceptable, to a number of delegations including our own.

As I indicated at the outset there is already a very general agreement on the limits of the jurisdiction of coastal states and the seabed authority, provided we can agree on their corresponding obligations. It is the negotiation of these duties that should be the main thrust of the negotiations this summer.

This is not, as some delegations have implied, an attempt to destroy the essential character of the economic zone—to give its supporters a juridical concept devoid of all substantive content.

On the contrary, the coastal states exclusive control over the nonrenewable resources of the economic zone is not being challenged. In the case of fisheries, coastal state management and preferential rights over coastal and anadromous species would be recognized. The principle of full utilization will ensure that renewable resources which might not otherwise be utilized will give some economic benefit to the coastal state and help meet the international community's protein requirements. Agreed international conservation and allocation standards for the rational management of tuna should in the long run benefit coastal states which seek to engage in fishing these species and would maintain the populations of the tuna that migrate through their zone. Finally most states are prepared to agree to coastal state enforcement jurisdiction with respect to resource exploitation within the economic zone.

Gentlemen, we have come to Caracas prepared to negotiate on these critical questions. They are not merely the legal fine print to be filled in once general principles have been agreed, but the very heart of the conditional consensus we are well on the way to achieving. Years of preparation have brought us to the moment when we must complete the task that we have undertaken. We must not let this opportunity pass.

Thank you, Mr. President.

MFR PAPER 1075

*Soviet vessels "constitute more than a quarter of the world's fishing fleet and more than one-half of the total tonnage . . ."*

# Soviet Fisheries: A Review

T. S. SEALY

At the end of the Second World War the Soviet fishing industry, which had produced a total catch of 1.4 million tons in 1940, was almost completely destroyed. More than 5,000 fishing vessels, almost the total complement of the USSR's western fishing fleet, had been lost and many of the ports, harbors and other shore facilities in the Azov, Black, Baltic and Northern sea areas were destroyed or extensively damaged.

However, in the 20 years from 1946 to 1966 the Soviet Union rebuilt and expanded its fishing industry so that by 1967 it had become the world's third largest catcher, after Peru and Japan, with a catch of 5.8 million metric tons, and had the world's largest national fleet of fishing and associated vessels. The USSR's catch at that time was around 11 percent of the world's total catch, whereas the population of the USSR was only around 7 percent of the world total.

This development was made possible only by a massive State investment in the industry (estimated at some $4 billion from 1946 to 1965), and by a centrally planned program of reconstruction and rebuilding through a series of five-year plans. The spur to this development was the Soviet Union's need to meet the continuing short-fall between the nation's protein requirement and agricultural production. A measure of the success achieved can be taken from the fact that fish and fish products are an established part of the average Russian's diet and that the industry provides around one third of the total annual consumption of animal protein in the Union.

The problems facing the industry at the end of the war were, however, immense. Reconstruction of damaged shore facilities took a large part of the available resources and the shipbuilding industry was almost entirely committed to a massive naval shipbuilding program. As a result the USSR bought fishing vessels extensively from abroad, particularly from the newly-created socialist states like Poland and East Germany through COMECON agreements. Although the USSR is now building a far greater proportion of its own vessels, foreign-built ships still comprise a very large part of the fleet.

In addition to the problems of reconstruction and rebuilding, the USSR also had to expand its fishing activities into nontraditional fishing areas and to seek new species in order to meet the catch targets set by the central planners. To do this the industry had to create an extensive research and development organization to develop new fishing techniques and methods in order to extend its operations into every ocean in the world.

The results of this dramatic and rapid expansion of the industry are manifold, affecting not only the internal economy of the USSR but also playing an important role in its foreign policy and in international agreements. As already noted the fishing industry is an important and essential part of the contemporary Soviet economy, not only in providing a significant contribution to the nation's food basket, but also as a large user of human and other resources. In addition to the fleet itself and its share in the ship-handling, shipbuilding, transportation, distribution, and food-production sectors of the economy, the industry is also managed and supported by a large centralized State administration and an extensive R and D and educational establishment. The worldwide operations of the fleet and its continued access to all ocean areas make it an important part of the USSR's relations with both developing and developed nations and in the international political arena generally.

*T. S. Sealy is Director, Martran Limited: Translators in Marine Technology, Southend-on-Sea, Essex, England.* *This paper originally appeared in the English publication* Underwater Journal, *in August 1973. We are grateful to the author and to the editors of* Underwater Journal *for permission to reprint it in the United States.*

## ADMINISTRATION

The Soviet government is responsible for determining the proportion of the State budget to be invested in the fishing industry, for setting the production targets for the industry in terms of the five-year plans and for integrating fishery production and the fishing industry into the overall economic plan. It is also responsible for fixing the salaries of persons engaged in the industry and for determining the market price of fish and fish products.

The central responsibility for the administration and development of the industry in terms of the "State plans for the National Economy" is vested in the Ministry of Fisheries. The Ministry controls the available funds and coordinates the general plan for all sectors of the industry from catching, processing, and distribution, to ship design and development, and fisheries R and D.

The Ministry, in turn, further delegates executive authority to various "Territorial Administrations," each responsible for some particular aspect of the industry, for example marine fisheries, freshwater fisheries and cultivation, and fisheries conservation and management.

**Figure 1.—Soviet Fisheries Research Vessel *Gizhiga*, converted BMRT.**

In the case of the marine sector of the industry, there are five such Territorial Administrations:

SEVRYBA, the Northern TA responsible for fishing operations in the White, Barents, and Norwegian Seas and the North and Central Atlantic Ocean;

ZAPRYBA, the Western TA responsible for fishing operations in the Baltic and North Seas and in the Central and Southern Atlantic;

AZCHERRYBA, the Azov/Black Sea TA responsible for fishing operations in the Black, Azov, Mediterranean, and Red Seas and the Indian Ocean;

KASPRYBA, the Caspian Sea TA responsible only for fishing operations in the Caspian Sea;

DAL'RYBA, the Far-Eastern TA responsible for fishing operations in the Sea of Okhotsk, the Bering Sea, and the Pacific and Indian Oceans.

These Territorial Administrations delegate authority to smaller administrative units—the Regional Administrations, which, in turn, control the smallest units, the "Collective" and "State" fishing enterprises.

The areas controlled by the Territorial Administrations bear no relationship to the boundaries of the Republics which constitute the USSR, a fact which emphasizes, once again, the national or "all-union" character of the industry.

## RESEARCH AND DEVELOPMENT

The expansion of the fishing industry is based upon its research and development effort which again is organized in the same pyramid fashion as the administrative side of the industry. At the top is VNIRO, the All-Union Scientific Research Institute for Fisheries and Oceanography in Moscow, and VNIRORKh, the All-Union Scientific Research Institute for River and Lake Fisheries in Leningrad. Both of these institutions are responsible to the Ministry which controls the overall planning of the research program.

VNIRO, as the central authority, is responsible for integrating the R and D programs of the Territorial Research Institutes under its umbrella. These are subdivided in exactly the same fashion as the Territorial Administrations, that is in SEVRYBA (Northern TA) there is PINRO (Polar Scientific Research Institute of Fisheries and Oceanography); ZAPRYBA (Western TA) has ATLANTniro (Atlantic Scientific Research Institute of Fisheries and Oceanography); AZCHERRYBA has AZCHERniro; KASPRYBA has KASPniro; and DAL'RYBA has DAL'niro.

Each of these research centers comprises a number of departments, not all of which are necessarily at the same location, so that all sectors of the industry relevant to that particular Territorial Administration can be investigated by teams fully acquainted with local problems.

Each Territorial Administration operates one or more fisheries research vessels. Many of these vessels are converted commercial fishing vessels which allows them to conduct comparative and feasibility studies of new gear and techniques under near-commercial fishing conditions, in addition to basic fisheries research work like the location, identification, and assessment of new stocks, studying environmental factors, plotting migration routes, and so on.

Typical of such vessels is the *Gizhiga* (Fig. 1) which is a converted BMRT. This particular vessel, which belongs to the ZAPRYBA TA and is based at Kaliningrad, undertook extensive fish surveys in the southwest

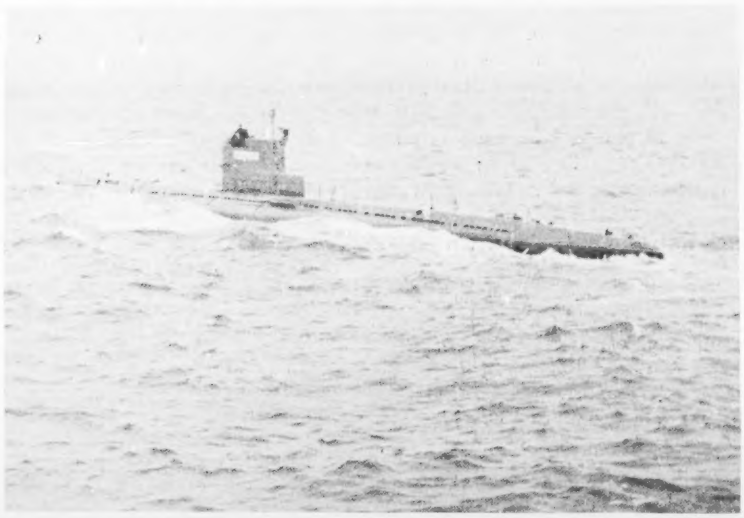

**Figure 2.—*Severyanka*, Soviet Fisheries Research submarine.**

Atlantic in 1966. As a result of her work a successful fishery has been established in the area (Table 3). It is true that since the establishment of this fishery in 1966, the recorded catches have fluctuated over a wide range. However in 1971, of the 12 countries (including Japan) exploiting the fishery, the Soviet fleet returned the third highest catch after Brazil and Argentina. In 1970 the Soviet fleet was the largest catcher in the area.

In addition to the surface vessels a number of submersibles are employed. These include "pure" fisheries research submersibles like the converted submarine *Severyanka* (Fig. 2) and small manned and unmanned, self-propelled and towed submersibles like *Batiplan* and *AMS-200*. These vehicles are used for making underwater observations of the operation and effectiveness of traditional and new designs of fishing gear. They also study the normal, near-gear, and escape behavior of different species of fish in the vicinity of such gear and the vessels operating them. Their use has played a vital role in the successful design of large-mesh midwater trawls, krill nets and associated fishing techniques, and submersible pump/light fishing systems.

A measure of the success of this approach to fisheries development can be seen in the fact that in 1972, 33 percent of the overall trawled catch from BMRT's (Large Freezer Trawlers) and above was by midwater trawl. From 1970 to 1972, 3,500 large-mesh midwater trawls of a new design were introduced into the fleet and almost all vessels are now equipped with this gear.

At the present time Soviet fisheries R and D is concentrated in two basic directions: the discovery of new, little, or unexploited stocks and the development of gear, vessels, and machinery to catch and process them effectively.

Examples of recent developments in this program are the discovery of large unexploited stocks of grenadier (*Macrurus rupestris*) at traditional fishing grounds, and the complementary development of a deep-water trawling technique to catch them.

The maximum working depth of conventional trawl gear is around 500 meters and it is for this reason that such fishing is concentrated on the continental shelf. However international competition on traditional grounds has already approached a level at which it is becoming increasingly difficult for catchers to maintain, let alone improve on, present catches. Because of this, the Soviet fishing industry set up an R and D program about 1965 to discover a new exploitable stock at depths in excess of 500 meters. As a result they discovered large stocks of grenadier at depths of around 1,000 meters off the northeastern shelf of the Great Newfoundland Bank and developed the gear and techniques to fish at this depth. A successful commercial fishery for this species has now been established.

Another development in the quest for new stocks is the fishery for krill (*Euphausia superba*), a small crustacean which forms the staple part of the diet of some species of whale and of seals and penguins. In this case, in addition to surveying the stocks and designing the gear and techniques to exploit it, the Soviets have also developed pastes, butter, and other food products from this raw material so that it can be readily used for both animal and human consumption. Although still in its early developmental stages, the Soviet industry anticipates that krill will be a major exploitable stock within a very short time.

In the field of mechanization, the USSR has pioneered the introduction of submersible and other fish pumps which are now widely used in the industry both for catching and transporting fish (vessel to vessel, ship to shore, dock to factory, and interfactory). Such pumps have done much to reduce manpower and to improve the quality of the finished product. This development has been accompanied by an increasing utilization of machines for all stages of processing both at sea and ashore.

## EDUCATION AND TRAINING

The expansion of the industry and the effective and rapid introducion into the fleet of the increasingly sophisticated results of the industry's R and D program depend upon a capable and highly skilled labor force.

To ensure that such a labor force is always available, the USSR has transformed its industry from the localized "community" industry, which is its most common form outside the Soviet Union, into a nationally recognized profession with a planned career structure. The result is that fishing is an attractive and accessible career to all citizens irrespective of sex or geographical origin, which enables the industry to select personnel on the basis of their ability rather than simply their availability.

Education and training play two important roles in this process: They help to attract young men and women seeking a higher education who might otherwise enter other professions, and; they provide a climate of professional interest and awareness which makes the acceptance, assimilation, and utilization of the results of R and D more rapid and effective.

Higher professional education is catered for, principally, by the "Technical Institutes for Fisheries and Fishing" of which there is one in each Territorial Administation. In addition to these polytechnics, which are entirely devoted to the industry, there are "food-industry" and "marine" polytechnics which provide specialized courses in relevant fields like fish processing, seamanship, navigation, and marine engineering. All these institutes provide full-time day and part-time evening and correspondence courses, all of which lead to a higher qualification or degree.

Each Territorial Administration has, therefore, its own comprehensive educational organization which benefits from the cross-fertilization of the practical experience of its fleet and the developmental work of its "Research Institute for Fisheries and Oceanography." In addition, this territorial organization is backed up by "national" educational centers like the All-Union Correspondence Institute for the Food Industry in Moscow which offers correspondence courses in fishing and fisheries leading to degree qualification. Some of the courses offered by this establishment are: ichthyology and fish cultivation; canning technology; fish product technology; ships' power plants; refrigerator and compressor plant and machinery; machines and apparatus; engineering economics; and the automation of food production.

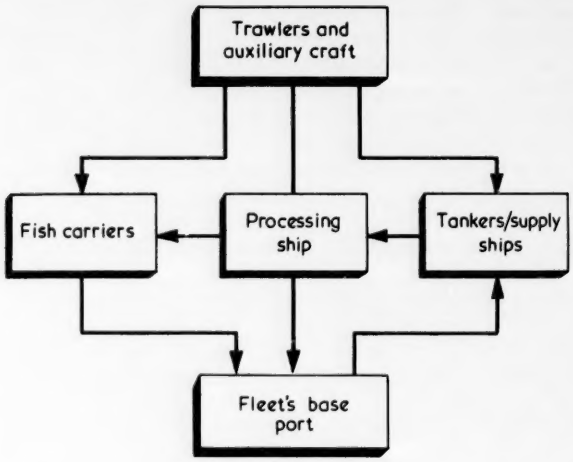


Figure 3.—Flotilla fishing organization.

All members of the industry, particularly the young, are encouraged to study through advertisements in the technical fishing press but also by the visible evidence that the attainment of a higher professional education provides for more rapid promotion, greater responsibility, and a higher salary.

Basic training in fishing skills is provided to all newcomers to the industry and comprises both onshore and at-sea training on specially-designed fishery training ships. A variety of such vessels exist, most of which are converted commercial vessels. One series of these are the *Nikolaj Zystar* class which were designed on the basis of the *Yantarnij* class fish processing/carrier ships (see Table 10). These particular vessels began construction in 1967 and the main design changes are in the superstructure and poop, and in the incorporation of additional accommodation, classrooms, training workshops, and so on.

## FISHING OPERATIONS

As already noted, the Soviet fishing industry has had to rapidly extend its area of operation on a worldwide basis in order to achieve, maintain, and improve its production. This requirement for the industry to operate at great distances from base ports brought about the development of "flotilla" fishing and it is this type of operation which has governed the design of Soviet fishing vessels and the structure of the fleet.

As the range of fishing activities gradually increased it became necessary to supply vessels with all essential consumables (fuel, salt, ice, water, provisions, and so on) while on the grounds in order to extend their operational time and range of operation (Fig. 3). It also became essential, in terms of greater safety and more effective operation, to support vessels at sea for extended periods of time with medical, spare-crew, and other facilities, and this could only be sensibly arranged if vessels were organized into flotillas under the direction and control of a large "mother" ship. The mother ship also had to be capable of relieving the fishing vessels of their catch and of processing it; otherwise the fleet may have been forced to leave profitable grounds because of full fish rooms or the possiblity that their catch might begin to spoil. Supported by tankers and fish carriers, the mother ship could now accept the trawlers' catch, process or partially process it, and then pass it on to the fish carriers for transportation to the base port. Similarly it could accept fuel, etc. for the whole flotilla from tankers and supply ships for distribution as the need arose (Fig. 4).

Flotilla fishing requires a highly complex organization and, because of the growing requirement to fish farther and farther away from the coastline of the Soviet Union, lines of communication between shore base and flotilla become more and more difficult to maintain, thus necessitating the design of new types of trawlers which were not only able to catch the fish but also to process and transport it, thus relieving the mother ships and fish carriers of some of the work load. The incorporation of such ships (factory, refrigerated, and freezer trawlers) has permitted a much greater variation in fishing operations, thus making the fleets and the industry as a whole a more adaptable and flexible organization. Figure 5 shows the

Table 1.—Total Soviet fish catch (in thousand metric tons), 1967-71.

| Year | At sea | Inland | Total |
|---|---|---|---|
| 1967 | 4,961.2 | 816.0 | 5,777.2 |
| 1968 | 5,301.6 | 780.5 | 6,082.1 |
| 1969 | 5,751.9 | 746.5 | 6,498.4 |
| 1970 | 6,398.8 | 853.4 | 7,252.2 |
| 1971 | 6,401.3 | 935.4 | 7,336.7 |

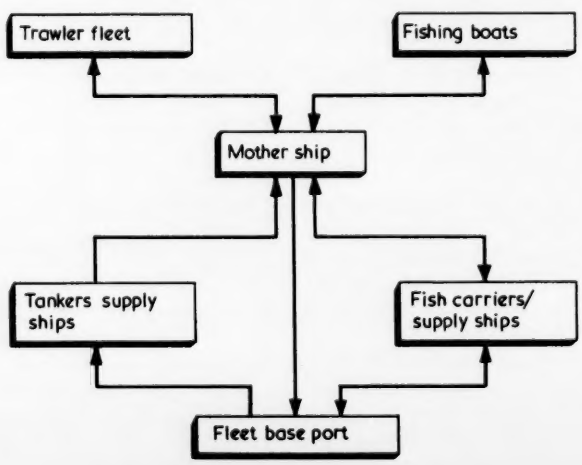


Figure 4.—Flotilla commanded by a mother ship.

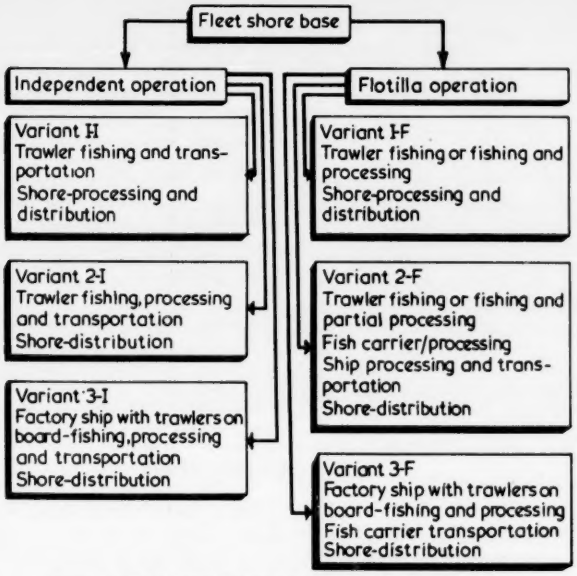


**Figure 5.—Basic Soviet methods of organizing fishing operations.**

variety of fishing operations today. Generally speaking, methods I-I and I-F are used for near-water fishing (up to 1,000 miles from the base port), methods 2-I and 2-F are used for middlewater fishing (1,000-3,500 miles from base port), and methods 3-I and 3-F for distant-water operations (3,500-5,000 miles from the base port).

## THE CATCH

In 1971, the USSR retained its place as the world's third largest fish catcher (as it has since 1967) with a catch totalling 7.3 million metric tons of which 6.4 million metric tons were caught at sea (Table 1). From 1965, the industry has increased its total catch by an average of 356,000 metric tons per annum.

The largest proportion of the catch is of demersal fish species, but pelagic species of all kinds contribute close to 40 percent of the total, (Table 2). The largest contributor to the demersal catch is Alaska pollock, which amounted to some 861.9 thousand metric tons in 1971 and which was caught exclusively in the North Pacific. The largest contributors to the pelagic catch in this year were jack- and horse-mackerel which totalled 435.7 thousand metric tons and were caught principally in the east-central Atlantic (329.6 thousand metric tons).

The largest overall catch (Table 4) is taken from the Atlantic (3,664.8 thousand metric tons in 1971), but the most productive ocean area is the northwest Pacific, which produced a catch of 1,562.1 thousand metric tons in 1971 (Table 3). The most heavily caught species in this area was Alaska pollock at 802.9 thousand metric tons. The most heavily caught pelagic species was herring at 282.4 thousand metric tons and this same area also produces the greater part of the shellfish catch (71.3 thousand metric tons).

In some ocean areas, particularly those in which the Soviet fleet pioneered the exploitation of the fishery, the increase in the catch is quite dramatic (Fig. 6). The catch in the northwest African fishery (East-Central Atlantic) was increased to 789.8 thousand metric tons in 1971.

There has been an even more dramatic increase in the Indian Ocean fishery where the catch has been increased from 47.0 thousand metric tons in 1970 to 242.4 thousand metric tons in 1971. Total catches have, however, fallen in the Mediterranean, southwest and northeast Atlantic, and the northeast and East-Central Pacific.

**Table 2. Species composition of Soviet catch, 1969-71.**

| Species | Catch in thousand metric tons per annum 1969 | 1970 | 1971 |
|---|---|---|---|
| Freshwater fish and shellfish | 388.3 | 410.9 | 469.0 |
| Diadromous fish | 530.5 | 689.6 | 706.2 |
| Pelagic marine fish | 1,846.1 | 1,895.3 | 1,971.4 |
| Demersal marine fish | 3,424.5 | 3,928.6 | 3,834.3 |
| Marine shellfish | 120.4 | 115.1 | 120.6 |
| Miscellaneous fish species | 188.6 | 212.7 | 235.2 |

As far as fisheries for individual species are concerned there was a fall in the USSR's tuna catch in 1971 to 8.3 thousand metric tons which reduced the 1970 catch by 4.3 thousand metric tons. This particular fishery is conducted in the East-Central Atlantic and Indian Oceans. The most productive area in 1971 was the East-Central Atlantic which provided 4.9 thousand metric tons.

The USSR continues to take virtually the whole of the world catch of the deep-water fishery for the grenadier which it pioneered. Conducted in the North Atlantic, the catch has been increased from 15,000 metric tons in 1969 to 82,600 metric tons in 1971.

Of the individual Soviet Republics (Table 5), the RSFSR (Russia) which has both the Sevryba and Dal'ryba Territorial Administrations within its borders, provides the greater share of the overall catch (5,078.2 thousand metric tons in 1971).

By far the greater proportion of the Soviet catch is processed for human consumption (Table 6). The propor-

**Table 3.—Total Soviet catch by sea area, 1967-1971.**

| Sea Area | Catch in thousand metric tons per annum 1967 | 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|
| Atlantic, NW & Arctic Sea | 624.3 | 801.4 | 986.2 | 812.3 | 1,021.5 |
| Atlantic, NE | 1,118.7 | 1,416.1 | 1,469.7 | 1,565.9 | 1,377.5 |
| Atlantic, West Central | 23.9 | 6.8 | 4.8 | 0.0 | 11.2 |
| Atlantic, East Central | 153.5 | 318.6 | 569.7 | 612.5 | 789.8 |
| Mediterranean & Black Sea | 300.6 | 284.8 | 138.7 | 302.5 | 263.7 |
| Atlantic, SW | 677.7 | 189.8 | 92.6 | 420.6 | 26.2 |
| Atlantic, SE | 251.0 | 484.5 | 407.2 | 422.6 | 438.6 |
| Indian Ocean, West | 38.2 | 10.3 | 20.8 | 47.0 | 239.8 |
| Indian Ocean, East | — | — | — | — | 2.6 |
| Pacific, NW | 1,204.2 | 1,302.2 | 1,394.0 | 1,447.6 | 1,562.1 |
| Pacific, NE | 569.1 | 434.3 | 642.8 | 747.6 | 656.0 |
| Pacific, East Central | — | 52.8 | 25.4 | 20.2 | 1.9 |
| Pacific, SW | — | — | — | — | 10.4 |

**Figure 6.—Soviet catch in the northwest African fishery (in thousands of metric tons), 1964-70.**

tion of the catch reduced to fish meal has increased from 237.0 thousand metric tons in 1965 to 427.2 thousand in 1971. Up to 1964 industrial fishing played a minor role and the total amount of industrial fishery products produced in that year was only 43.9 thousand metric tons. At this time, however, many vessels in the fleet were equipped with on-board fish-meal plants to reduce the offal (heads, skins, etc.) from processing operations. As a result, the production of this and associated products increased dramatically. As the size of the fleet and its range of operations increased, greater and greater attention has been paid to the prosecution of an industrial fishery based on underutilized species unsuitable for human consumption. The development of this sector of the industry will be further increased by the recent introduction into the fleet of vessels specifically designed to conduct an industrial fishery.

**Table 4.—Total Soviet catch by ocean (in thousand metric tons), 1967-1971.**

| Year | Atlantic | Pacific | Indian |
|---|---|---|---|
| 1967 | 2,847.9 | 1,773.3 | 38.2 |
| 1968 | 3,209.8 | 1,789.3 | 10.3 |
| 1969 | 3,526.7 | 2,062.2 | 20.8 |
| 1970 | 3,833.1 | 2,215.4 | 47.0 |
| 1971 | 3,664.8 | 2,230.4 | 242.4 |

## THE FLEET

Today the Soviet fleet comprises a total of 3,741 vessels over 100 grt which constitute more than a quarter of the world's fishing fleet and more than one-half of the total tonnage of this fleet. As Tables 7 and 8 show, the Soviet fleet is made up of 3,247 trawlers and other fishing vessels (around one-fifth of the world total) plus 494 fish carriers and fish factory and mother ships which is more than three-quarters of the total world fleet of such ships.

The fleet as a whole can be subdivided into four basic vessel groups: mother ships; fish processing and carrier ships; factory trawlers; other trawlers and fishing vessel types.

### Mother Ships

The first Soviet-built postwar mother ships were the *Andrej Zakharov* class which were built during the seven-year plan 1959-1965. The total series comprised 13 ships, the last of which, the *Aleksandr Kotrysev*, was completed in 1966. The name ship of the series was completed in 1960 and its principal particulars are given in Table 9.

This ship carries 12 motor fishing boats (each weighing from 15 to 30 tons) mounted under davits arranged along both sides. On reaching the grounds these boats are lowered for fishing operations and on completion are carried back to the base port by the mother ship. This class is designed to work not only with its own boats, but also with a flotilla of other fishing vessels, being able to process and store their catch and supply them with provisions, fuel, ice, etc.

The ships' factory plant is designed primarily for canning the catch (princi-

**Table 7.—Trawlers and other fishing vessels (number of vessels of gross registered tonnage), 1969-1972.**

| Tonnage | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|
| 100-499 | 1,872 | 1,850 | 1,870 | 1,922 |
| 500-599 | 335 | 364 | 644 | 688 |
| 1,000-1,999 | 15 | 37 | 60 | 63 |
| 2,000 and over | 322 | 432 | 534 | 574 |
| Total | 2,604 | 2,683 | 3,108 | 3,247 |

**Table 8.—Fish carriers and factory ships (number of vessels of gross registered tonnage), 1969-1972.**

| Tonnage | 1969 | 1970 | 1971 | 1972 |
|---|---|---|---|---|
| 100-1,999 | 102 | 114 | 135 | 164 |
| 2,000-3,999 | 56 | 77 | 102 | 106 |
| 4,000-5,999 | 56 | 69 | 84 | 86 |
| 6,000-9,999 | 24 | 34 | 38 | 38 |
| 10,000 and over | 66 | 78 | 96 | 100 |
| Total | 304 | 372 | 455 | 494 |

**Table 5.—Total Soviet marine catch by republics, 1967-71.**

| Republic | Catch in thousand metric tons per annum | | | | |
|---|---|---|---|---|---|
| | 1967 | 1968 | 1969 | 1970 | 1971 |
| Armenia | 1.1 | 1.0 | 1.1 | 1.2 | 0.9 |
| Azarbajyan | 65.5 | 62.2 | 64.0 | 73.2 | 72.6 |
| Byelorossiya | 7.3 | 7.9 | 6.2 | 9.0 | 9.3 |
| Estonia | 207.0 | 262.7 | 286.3 | 305.1 | 337.8 |
| Georgia | 61.4 | 74.2 | 80.2 | 85.8 | 89.1 |
| Kazakh | 103.5 | 102.4 | 99.1 | 105.4 | 100.8 |
| Kirgiz | 1.4 | 1.3 | 1.3 | 1.5 | 1.7 |
| Latvia | 358.5 | 393.7 | 413.1 | 441.1 | 474.4 |
| Lithuania | 269.0 | 288.2 | 328.1 | 376.7 | 378.6 |
| Moldavia | 1.8 | 1.8 | 2.5 | 3.2 | 3.3 |
| Russia | 4,199.8 | 4,335.6 | 4,635.6 | 5,147.2 | 5,078.2 |
| Tadzhik | 0.4 | 0.5 | 0.6 | 0.9 | 1.0 |
| Turkmen | 46.7 | 46.5 | 50.6 | 61.7 | 64.6 |
| Ukraine | 441.1 | 495.5 | 518.4 | 629.4 | 712.6 |
| Uzbek | 12.7 | 8.5 | 11.3 | 10.8 | 11.8 |

**Table 6.—USSR marketed fish production 1966-71.**

| Product | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|---|
| Fish: fresh, chilled, and frozen | 1,766.1 | 1,878.9 | 1,951.5 | 2,307.9 | 2,557.3 | 2,449.8 |
| Fish: dried, salted, or smoked | 739.5 | 786.0 | 797.1 | 734.8 | 720.6 | 658.1 |
| Fish: canned or packaged | 485.5 | 516.6 | 547.3 | 617.1 | 689.9 | 742.9 |
| Shellfish products | 6.3 | 5.4 | 5.4 | 4.8 | 3.9 | 3.4 |
| Oil and fats | 157.1 | 175.8 | 155.7 | 162.2 | 167.0 | 152.1 |
| Meal and animal feedstuffs | 264.5 | 324.8 | 348.0 | 374.1 | 393.1 | 427.2 |

**Figure 7.—*Pionersk*, a mother ship of the *Korablestroitel Klopotov* type.**

pally herring, mackerel, shrimp, and sardine) and for producing fish meal and oil.

The ships are three-decked, single-screw motor ships with the machinery aft and the bridge superstructure forward. The factory, workshops, and accommodation are amidships.

This series provided the basis for a new series named the *Korablestroitel Klopotov* class which started building in 1967. The two classes are outwardly similar and, as can be seen from Table 9, have basically similar principal particulars. The principal improvements in the new class are a 72 percent increase in the production of the canning factory, the ability to produce frozen products, and an increased factory and refrigerated hold volume due to the reduction in the size of the crew. A Polish-built mother ship of this type is shown in Figure 7.

An example of a special purpose mother ship is the *Leninskij Luch*, which is a tuna mother ship built for the Soviet fleet in Japan in 1964. This particular vessel carries six catcher boats and has an endurance of around 126 days. Her principal particulars are:

| | | | |
|---|---|---|---|
| Length, o.a. | 115.0 m | Draft | 5.5 m |
| b.p. | 105.0 m | Speed | 14 knots |
| Breadth | 17.4 m | Complement | 180 |
| Depth | 8.8 m | | |

Her catcher boats have the following particulars:

| | | | |
|---|---|---|---|
| Length | 16.0 m | Draft | 1.0 m |
| Breadth | 4.0 m | Displacement | 34 tons |
| Depth | 1.6 m | Deadweight | 12.6 tons |

Soviet fishing operations in the tropical latitudes of the Atlantic, Pacific, and Indian Oceans began in the middle 60's. However, apart from the *Leninskij Luch* none of the existing classes of mother ship were really suitable for tropical operation and a new class was designed specifically for this objective.

The lead ship of the new class, the *Vostok* (Fig. 8) was launched from the Admiralty yard, Leningrad in April 1969 and entered service in 1971. The principal particulars of the vessel are given in Table 9.

The *Vostok* is a four-deck, twin-screw, vessel with its machinery aft and superstructure forward. The ship carries its own fishing fleet of fourteen *Nadezhda* fishing boats (Fig. 16) and the hull incorporates a stern ramp for taking on the catches from the boats. The ship is powered by two geared turbine sets each developing 13,000 hp coupled to fixed-pitch propellers.

In order to make more effective use of the internal volume of the ship, special systems are incorporated for preparing and cleaning empty fuel tanks for the stowage of canned products and fish meal.

The *Vostok* is fitted with a computer for calculating the optimal organization of any particular fishing operation, and an operations/communication center with all-round observation for directing fishing operations. Two helicopters, fitted with fish finding gear, are also carried to aid fish search.

Accommodation and facilities for the crews and factory personnel are of a high standard and include mainly two-berth cabins, a deck sports area, a swimming pool, cinema, library, reading room, classrooms, a club and cultural center, and dining rooms.

During passage to and from the grounds the *Nadezhda* boats are carried seven on each side of the upper deck of the *Vostok* on fixed raised chocks, which stand either side of a pair of rails. The rails are used by self-propelled trolleys (two on each side) which carry keel blocks that can be raised and lowered hydraulically. When the *Nadezhda* boats are to be lowered the trolley runs underneath the boat which is sitting on its chocks in the stowed position. The keel blocks on the trolley are raised under the boat, lifting it free of its towage position. The trolley then transports the

**Figure 8.—The mother ship *Vostok*.**

**Table 9.—Soviet-built factory ships.**

| Principal Particulars | *Andrey Sakhorov* | *Korablestroitel Klopotov* | *Vostok* | *Brotej Khabaraov* | *Pos'et* |
|---|---|---|---|---|---|
| Year of Building | 1960 | 1967 | 1969 | under construction | 1972 |
| Length, o.a., m | 182.17 | — | 225 | 177.6 | 197.3 |
| Length, b.p., m | 150.0 | 150 | — | | 182.0 |
| Breadth, m | 20.0 | 20 | — | 24.0 | 26.4 |
| Depth, m | 12.5 | 12.5 | — | 14.0 | 14.5 |
| Draft, m | 7.02 | 7.02 | — | 8.1 | 7.7 |
| Displacement, loaded, tons | 15,300 | 15,300 | 43,400 | 22,600 | 28,200 |
| Power, main engine, h.p. | 3,800 | 2×2,000 | — | 9,000 | 9,000 |
| Speed, knots | 12.5 | 12.7 | 19 | 15 | 14.5 |
| Capacities, $m^3$: | | | | | |
| Frozen products | — | 1,200 | — | 4,500 | 6,000 |
| Preserved products | — | 1,430 | — | — | — |
| Canned products | — | 1,385 | — | — | — |
| Fish meal | — | 400 | — | — | — |
| Overall daily factory throughput: | 3,165 | 4,415 | 28,000 | 13,300 | 15,400 |
| Canning, cans/day | — | 288,000 | 150,000 | 360,000 | — |
| Preserving, cans/day | — | 20,000 | — | — | — |
| Frozen products, tons | — | 20 | 180,000 | 60 | — |
| Fish meal, tons | — | 40 | 20-25 | 70 | 110-120 |
| Deadweight | — | — | 21,700 | — | — |
| Endurance, days | — | — | 125 | 75 | 120 |
| Complement | 640 | 520 | 600 | 600 | 500 |
| Range, n. m. | 11,000 | — | — | — | — |

boat along the deck to a bridge crane (one on each side) which lowers the boat into the water.

The *Nadezhda* boats themselves are stern trawlers with GRP hulls and are able to fish with bottom and mid-water trawls, purse-seines, dip-nets, and electric light. Their principal particulars are:

| | | | |
|---|---|---|---|
| Length, o.a. | 17 m | Power, main | |
| Beam | 5.3 m | engine | 600 hp |
| Displacement | 69 tons | Crew | 5 |

When fishing is finished the catch is set afloat in either the separable cod-ends, net sacks, or special containers to be picked up by the *Vostok* via its stern ramp.

Another new mother ship design intended for tropical operation is the *Erofej Khabarov* class. This vessel is a single-screw three-deck ship with the machinery aft and superstructure forward. The vessel has a displacement of 22,600 tons dwt, main engine power of 9,000 hp, and a speed of 15 knots. The factory has a daily production capacity of 60 tons of frozen fish, 360,000 × 0.25 kg canned fish products, 22,000 × 5 kg cans and 70 tons of fish meal and oil. Total cargo capacity is 13,500 $m^3$. The catch from the fishing vessels is taken aboard by both conventional deck handling gear and a fish pump of 50 tons/hr capacity.

Among the most recent introductions into the fleet is the *Pos'et*, a fish-meal mother ship designed for flotilla operation with traditional vessels but particularly with the new all-purpose seiners of the *Rumb* class.

The *Pos'et* is specifically designed to exploit the North Pacific fishery for Alaska pollock which is an ideal raw material for fish meal production. Her principal particulars are as follows:

| | | | |
|---|---|---|---|
| Length o.a. | 197.3 m | Depth | 14.5 m |
| Length b.p. | 182.0 m | Draft | 7.7 m |
| Breadth | 26.4 m | Speed | 14.5 knots |

This ship is equipped to take four trawlers alongside at any one time, their catch being taken on board by derricks and fish pumps. The factory is able to receive up to 800 tons of fish daily and to produce 25 tons/day each of frozen fillets, frozen gutted fish, frozen whole fish, edible frozen fish cakes; 5 tons/day each of salted roe and vitamin A (all of these products are packed for marketing); and 12 tons/day of fish oil, in addition to 110-150 tons/day of fish meal.

The factory plant incorporates four fish meal machines with a total capacity of up to 150 tons/day together with cookers and associated fish meal equipment. The fish gutting machine area together with the sorting and processing areas are designed for the complete utilization of up to 600 tons of fish.

The refrigerating plant has a total capacity of 100 tons/day plus a special unit of 4 tons/day capacity for freezing large fish. Accommodation includes a cinema, classrooms, library, and lounge, in addition to cabins.

## Fish Carrier/Processing Ships

Table 10 gives the principal particulars of the PTS-type fish carriers which were built in the late 50's and early 60's. These vessels are comparatively small and are used for transporting the catch of vessels operating in near-range grounds.

Other typical short and medium-range fish carriers are the Soviet-built *Petrozavod* and *Zelenodolsk* classes. The *Petrozavod* class are single-screw, single-deck vessels designed for reducing the catch to fish meal and oil and for transporting the same to the base port. All fish handling is mechanized and controlled automatically. The vessels have a displacement of 1,700 tons, main engine power of 1,000 hp, two fish pumps of aggregate capacity 400 $m^3$/hr, cargo space of 670 $m^3$, fish oil capacity of 35 $m^3$, and fish room capacity of 32 $m^3$. The output of the reducing plant is 60-70 tons/day.

The *Zelenodolsk* class is intended for near-water operation and is designed to freeze and transport the catch taken from fishing vessels. She is, however, capable of conducting a pump-fishery for kilka (sprat). Her principal particulars are:

| | |
|---|---|
| Displacement | 1,150 tons |
| Main engine, power | 800 hp |
| Freezing rate | 15 tons/day |
| Refrigerated cargo space | 360 $m^3$ |
| Endurance | 18 days |

Since 1959 the Soviet Union has built five principal classes of long-range refrigerated fish carriers: the *Tavriya* class built from 1959 to 1967, totalling six ships; the *Dalnevostochnij* class built from 1960 to 1963 totalling three ships; the *Sevastopol* class built from 1959 to 1961 totalling six ships; the *Sibir* class built from 1963 to 1967 totalling twenty ships; and the *Yantarnij* class built from 1966.

The principal particulars of these classes are given in Table 11. Of course, in addition to these vessels there are a very large number of fish carriers/processors built outside the USSR, like the *Veter* class (Fig. 9). These particular vessels, of 135 m length o.a. and 4,700 grt, were built in West Germany in 1964.

The *Tavriya* class are refrigerated freezer/fish carriers designed to receive, freeze, and transport processed or whole fish caught by trawlers operating in the northern and southern Atlantic and Pacific oceans. They are single-screw ships with machinery and superstructure aft.

The trawlers' catch is taken aboard by six 3-ton capacity derricks (two

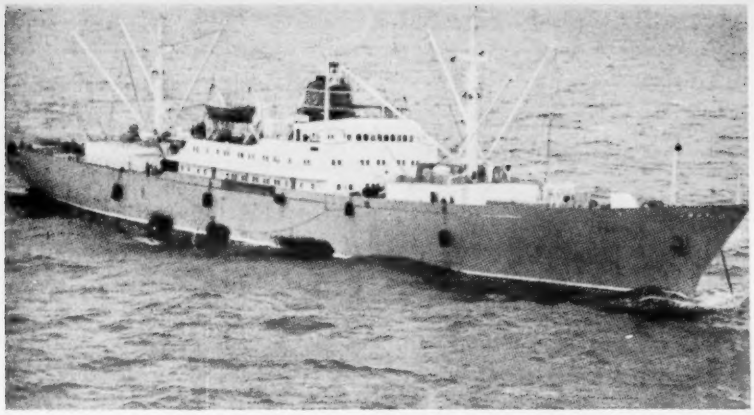

**Figure 9.—*Tajfun*, a *Veter* class refrigerated fish carrier.**

to each hold) and by one 10-ton capacity heavy lift gear. Each hold is fitted with a fish elevator of up to 40 tons/hr capacity and internal fish conveyors to speed up fish handling.

The main machinery comprises four DC diesel generators each of 760 kW at 470V/740 rpm and a twin-armature electric propulsion motor.

The *Sevastopol* is a larger ship with a deckhouse and machinery aft and a superstructure amidships. The hull is strengthened for operation in ice and the ship is intended for receiving, storing, and transporting whale meat or fish. Cargo space comprises four holds and four 'tween decks arranged forward and aft of the central superstructure.

The main machinery comprises four diesel generators with an output of 1,250 kW at 810 rpm acting on a single shaft. The rated power of the main generators is 1,375 kW at 500V/810 rpm and the rated power of the twin-armature DC electric propulsion motor is 2 × 3,500 hp.

The *Yantarnij* class (Fig. 10) is an improved *Sevastopol* design and the two classes have the same principal particulars. The main improvements are in crew accommodation and cargo-handling, the former by better air-conditioning, and the latter by improved capacity freezers, automation, and so on.

This group of five Soviet-built classes has now been increased by the lead ship of a new class 50 LET SSSR which was built in 1972. This vessel is the largest fish carrier/processor vessel in the world and her principal particulars are as follows:

| | |
|---|---|
| Length o.a. | 172.1 m |
| Length b.p. | 160.0 m |
| Breadth | 23.0 m |
| Depth | 13.7 m |
| Draft | 8.1 m |
| Displacement: | |
| Empty | 8,300 tons |
| Loaded | 19,630 tons |
| Deadweight | 11,330 tons |
| Capacity: | |
| Frozen fish | 8,230 tons |
| Power, max. | 11,600 hp |
| Speed, trials | 19 knots |
| Range | 25,000 miles |
| Capacities: | |
| Refrigerated holds | 16,200 m³ |
| Fuel | 7,100 m³ |
| Water | 900 m³ |

## Factory Trawlers

Soviet factory trawlers comprise a wide variety of types built in a number of countries, notably Poland, East Germany, Denmark, the Netherlands, and France.

The first factory trawlers in the Soviet fleet were the large stern freezer trawlers (Soviet type designation BMRT). Three classes of this type of factory trawler are in operation in the fleet but only one of them, the *Majakovskij*, was built in the USSR. The other two classes, which are basically similar, were built in Poland and East Germany. The lead ship of the East German class, *Atlantik*, is shown in Figure 11.

The *Majakovskij* class started building in 1957 and the name ship of the series began operation in the summer of 1958. Well over a hundred of these vessels were built during the first ten years of the series' operation. In all, there were 240 *Mayakovskij*-class BMRT's in the fleet in 1972.

The principal particulars of the *Majakovskij* class are:

| | |
|---|---|
| Length o.a. | 84.7 m |
| Length b.p. | 75.0 m |
| Breadth, mld. | 14.0 m |
| Depth, to main deck | 10.0 m |
| Draft, mean on setting out to the grounds (no catch, full stores and packing materials) | 5.54 m |
| Draft, mean on completion of operations (100% fish products, 25% stores) | 5.52 m |
| Displacement, on setting out to the grounds | 3,658 tons |
| Displacement, on completion of operations | 3,638 tons |
| Deadweight, on setting out to the grounds | 1,301 tons |
| Hold capacities: | |
| No. 1 (Refrigerated) | 290 m³ |
| No. 2 (Refrigerated) | 630 m³ |
| No. 3 (Refrigerated) | 410 m³ |
| No. 4 (Fish meal) | 170 m³ |
| No. 5 (Canned products) | 124 m³ |
| Tank capacities: | |
| Fish oil | 37 m³ |
| Diesel fuel | 565 m³ |
| Boiler fuel | 263 m³ |
| Fresh water | 285 m³ |
| Gross tonnage | 2,450 reg. tons |
| Net tonnage | 960 reg. tons |
| Power, main engine | 2,000 hp at 250 rpm |
| Speed (at displacement 3,658 tons) | 13 knots |
| Range | 16,000-17,000 nautical miles |
| Endurance | 80 days |
| Complement | 104 |

The main engine is a 8DR-43/61B1 diesel engine manufactured by

**Table 10.—PTS-type fish carriers.**

| Principal Particulars | PTS-33 | PTS-73 | PTS-1 | PTS-14 | PTS-150 | PTS-150B | PTS-89 |
|---|---|---|---|---|---|---|---|
| Country of building | USSR | USSR | USSR | USSR | USSR | USSR | USSR |
| Year of building | 1957 | 1957 | 1960 | 1961 | 1963 | 1963 | 1964 |
| Length, o.a., m | 26.7 | 27.10 | 27.21 | 27.3 | 27.10 | 25.05 | 27.10 |
| Breadth, extreme, m | 5.5 | 5.5 | 5.5 | 5.5 | 5.65 | 5.5 | 5.5 |
| Depth, m | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Draft, m | 1.89 | 1.8 | 1.8 | 2.16 | 1.87 | 1.87 | 2.0 |
| Gross tonnage, reg. tons | 107 | 100 | 107 | 107 | 100 | 100 | 100 |
| Net tonnage, reg. tons | 35 | 31 | 40 | 40 | 40 | 40 | 40 |
| Deadweight, tons | 27 | 42 | 54 | 54 | 59 | 59 | 50 |
| No. of non-refrigerated cargo holds | None | 2 | 2 | None | None | 2 | None |
| Cubic capacity, m³ | — | 32;34 | 21;20 | — | — | 32;34 | — |
| No. of refrigerated cargo holds | 2 | None | None | 2 | 2 | None | 2 |
| Cubic capacity, m³ | 32;34 | — | — | 32;34 | — | — | 2 × 33 |
| Engine type and number | 1 × Diesel | 1 × Diesel | 1 × Diesel | 1 × Diesel | 1 × Diesel | 1 × Diesel | 1 × Diesel |
| Speed, knots | 8 | 8.9 | 8.8 | 8.8 | 8.9 | 8.9 | 8.9 |
| Refrigerant | Freon-12 | None | None | Freon-12 | Freon-12 | None | Freon-12 |
| No. of Compressors | 1 | — | — | 1 | 1 | — | 1 |
| Temperature in refrigerated holds, °C | 2×(−2°C) | — | —2×(−2°C) | | 2×(−2°C) | | —2×(−2°C) |

**Figure 10.—A *Yantarnij* class fish processing/carrier ship.**

**Table 11.—Soviet series-built refrigerated fish carriers.**

| Principal Particulars | *Tavriya* | *Dalnevostochnij* | *Sevastopol* | *Victor Vasnetsov Sibir* Class |
|---|---|---|---|---|
| Length, o.a., m | 99.35 | 99.35 | 130.9 | 130.0 |
| Breadth, extreme m | 14.0 | 14.03 | 16.5 | 16.83 |
| Depth, m | 7.23 | 7.23 | 9.5 | 9.54 |
| Draft, m | 5.65 | 5.74 | 6.6 | 7.22 |
| Gross tonnage, reg. tons | 3,230 | 3,230 | 5,524 | 6,133 |
| Net tonnage, reg. tons | 1,130 | 1,130 | 2,448 | 2,947 |
| Deadweight, tons | 2,544 | 2,638 | 4,230 | 5,285 |
| Hold capacities, $m^3$ | | | | |
| No. 1 | 300 | 890 | 850 | 1,752 |
| No. 2 | 640 | 1,380 | 1,460 | 1,836 |
| No. 3 | 680 | 1,000 | 1,460 | 1,845 |
| No. 4 | NONE | NONE | 1,608 | 1,780 |
| Temp. of above °C | 3×(−18°C) | 3×(−18°C) | 3×(−18°C) | — |
| Refrigerant | Ammonia | Ammonia | Ammonia | Ammonia |
| Speed, knots | 13.5 | 13.6 | 16.6 | 16.5 |
| Endurance, days | 60 | — | 40 | 60 |
| Range, n. m. | 8,000 | — | 8,000 | 10,000 |
| Complement | 82 | — | — | — |

the Russkij Dizel Factory. The electric power plant comprises four three-phase, 230 V, AC Diesel generators each developing 224 kW. The diesels have a rated output of 300 hp at 750 rpm.

The factory area comprises a processing section, an oil production section, a canning section, and a fish meal section. The processing section is fitted with two twin-duct fish freezing rooms of -35°C and a packing room. Two automated gutting lines produce fillets of cod, and a third line produces headed and gutted fish. This section can produce up to 20 tons of frozen fillets and up to 10 tons of frozen, headed fish daily.

The oil production section is fitted with two boilers for rendering down cod livers. The canning section is fitted with two autoclaves and a canning machine. The fish meal production section has two single-drum units which can handle up to 20 tons of fish offal daily.

The trawler is fitted with an ammonia refrigerating plant which provides a temperature of -18°C in the fish rooms.

Another group of factory trawlers is of the Soviet type designation RTM. This group comprises two classes: the *Sever* built in the Soviet Union in 1966, and the *Tropik* built in East Germany from 1962 (Figs. 12 and 13).

The *Sever* is designed as a freezer/wet-fish factory trawler and is designed for operation in the Barents Sea and North Atlantic using bottom trawl nets for catching cod and redfish and midwater trawls for herring. Her principal particulars are:

| | |
|---|---|
| Length o.a. | 71.0 m |
| Length b.p. | 64.0 m |
| Breadth | 13.1 m |
| Depth, to upper deck | 8.2 m |
| Draft, at design waterline | 4.8 m |
| Displacement, lightweight | 1,780 tons |
| Displacement, loaded | 2,540 tons |
| Gross tonnage | 2,025 reg.tons |
| Net tonnage | 758 reg.tons |
| Cargo Capacities: | |
| Refrigerated | 807 $m^3$ |
| Non-refrigerated | 133 $m^3$ |
| Overall | 940 $m^3$ |
| Speed | 13.3 knots |
| Range | 11,000 nautical miles |
| Complement | 51 |

The hull is all-welded, transversely framed, and the bow is strengthened for operation in ice.

A unified power plant provides all the ship's needs and comprises three automated AC diesel generators each developing 700 kW at 400V/750 rpm. Propulsion is provided by a synchronous electric propulsion motor which drives a ducted c.p. propeller. At anchor, electricity is supplied by a standby diesel generator with a rated output of 100 kW. Steam requirements are met by a 2.5 tons/hr auxiliary watertube boiler and three 250 kg/hr waste-heat boilers.

The ammonia refrigerating plant is able to freeze 20 tons/day of fish to -23°C, produce 5.5 tons/day flake ice and maintain a temperature of

**Figure 11.—*Atlantik*, below, an *Atlantik* class BMRT.**

**Figure 12.—A *Tropik* class RTM transferring its catch to a refrigerated fish carrier.**

-25°C in a frozen products hold, a temperature of -2°C to -25°C in the refrigerated hold, and a temperature of -2°C in the canned products hold. Provisions stores are cooled by a Freon plant.

The trawl, which has an overall pull on the warp drums of 12 tons takes in the warps at a speed of 60 m/min. The stern ramp is 3.6 m wide and is closed by a door (hinged at the lower edge) when not in use.

Some other types and classes are:

The *Skryplev* class (Soviet type designation TPR) built in Denmark in the early 60's with a length, o.a., of 102.4 m and of 4,700 grt, intended for operations in the North Atlantic (Fig. 14).

The *Mintaj* class (Soviet type designation BMMRT), building in the USSR and intended for bottom and midwater trawling in the Japan and Okhotsk Seas. This vessel is a twin-deck, single-screw stern trawler and her principal particulars are as follows:

| | |
|---|---|
| Displacement, loaded | 3,660 tons |
| Power, main engine | 2,000 hp |
| Speed | 12.5 knots |
| Daily output: | |
| Frozen fish | 30 tons |
| Fish meal and oil | 70 tons |
| Cod-liver oil | 9.6 tons |
| Caviar | 560 kg |
| Cargo space | 1,330 $m^3$ |
| Endurance | 60 days |

The *Altaj* class (Soviet type designation PR). This vessel is a combination mother ship and factory trawler being designed to receive the catch of accompanying vessels in addition to carrying out trawling via her own stern ramp. The *Altaj* is propelled by a diesel-electric installation and her principal particulars are:

| | |
|---|---|
| Displacement | 5,671 tons |
| Deadweight | 1,520 tons |
| Power, main engine | 5,000 hp |
| Speed | 14 knots |
| Daily output: | |
| Frozen fish | 50 tons |
| Fish meal | 30-35 tons |
| Refrigerated cargo space | 3,100 $m^3$ |
| Capacity, fish meal holds | 350 $m^3$ |
| Range | 10,000 nautical miles |

**Figure 13.—*Vololas* (right, middle), a *Tropik* class RTM.**

**Figure 14.—*Gol'fstrim* (right, bottom), a *Skryplev* class TPR.**

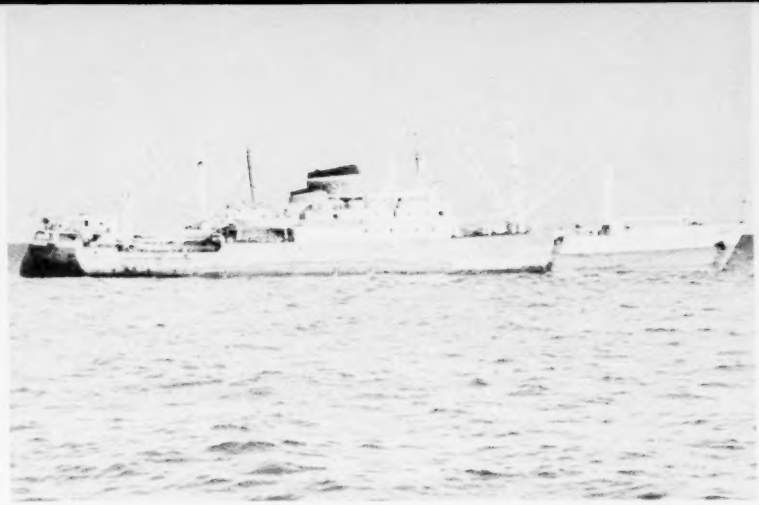

**Figure 15.—Two BKRT's (large stern canning trawlers).**

The *Nataliya Kovshova* class (Soviet type designation BKRT) (Fig. 15). These large stern trawling, canning factory trawlers were built in France in 1966 and have the following principal particulars:

| | |
|---|---|
| Length o.a. | 127.7 m |
| Length b.p. | 115.0 m |
| Breadth | 19.0 m |
| Depth | 12.0 m |
| Deadweight | 4,410 |
| Displacement | 9,840 |
| Draft, loaded | 6.9 m |
| Speed | 13.7 knots |
| Endurance | 120 days |
| Complement | 238 |

The *Meridian* class, which has only very recently been completed, is an improved design of the *Majakovskij* BMRT. Its principal particulars are:

| | |
|---|---|
| Length o.a. | 103.1 m |
| Length b.p. | 94.0 m |
| Breadth | 16.0 m |
| Depth | 10.2 m |
| Draft | 5.0 m |
| Displacement | 5,600 tons |
| Deadweight | 1,980 tons |
| Speed | 16 knots |

The *Gorizont* is a new design of stern factory/freezer trawler at present under construction in the USSR. Her principal particulars are:

| | |
|---|---|
| Length o.a. | 112.8 m |
| Length b.p. | 100 m |
| Breadth | 17.3 m |
| Depth | 11.0 m |
| Displacement | 7,950 tons |
| Draft | 6.52 m |
| Deadweight | 3,050 tons |
| Range | 4-5,000 nautical miles |
| Endurance | 100 days |
| Complement | 90 |

## Other Vessel Types

Naturally enough, this group comprises the largest and most varied part of the fleet (Fig. 16) and it is perhaps sensible to divide them into two groups: those built prior to the introduction of stern trawlers (the middle 60's) and those built after it.

### Vessels Entering The Fleet Prior to 1965

The principal trawler types of the early postwar years were the small and standard type trawlers (Soviet type designations MRT and RT respectively), and, although no longer typical, these vessels are still in use today.

The MRT's (Table 12) are used exclusively for coastal fishing (20-100 miles from the coast). They are single-deck, two-masted drifters and are divided into two groups, the STB-80 (steel hulls) and the TRB MRT (wooden or composite hulls). The improved version of this type is the small refrigerated trawler (Soviet type-designation MRTR), whose principal particulars are also given in Table 12 (Fig. 16).

The RT trawlers are larger side trawlers powered either by steam engines of 650-1,000 hp or diesel engines of 800-1,100 hp. Virtually all of the steam-powered vessels have now been phased out. The RT's are drifter/trawlers able to stow the catch either wet or salted and to produce semiprocessed fish meal and fish oil. Some were also able to can part of the catch. This trawler type can be roughly divided into three main groups: those built from 1947 in Finland, Sweden, and Poland; those built from 1952 in the Soviet Union; those built from 1956 to 1958, the Belgian-built *Kreml* class, and the British-built *Pioneer* class.

The *Pioneer* class RT's (Fig. 17), which were built by Brooke Marine, were a highly successful design which has been extensively used by the Soviet Union for later vessels like, for example, the later Soviet built RTR's (refrigerated standard trawlers) as shown in Figure 18. The principal particulars of a number of RT trawlers are given in Table 13.

Other trawler types built in the late 50's and early 60's were the NIS, RS, and SRS trawlers. The principal particulars of these types are given in Tables 14, 15, and 16.

The first Soviet-built medium trawler (Soviet type-designation SRT) was the *Korablestroitel* built in Murmansk in 1947. This vessel was a side drifter/trawler designed for catching herring and bottom fish using drift and trawl nets. Provision was made for the salt or wet stowage of the catch. Series built SRT's, basically similar to the *Korablestroitel*, were ordered from East Germany in 1949 (Table 17).

The first series of SRT's built in the Soviet Union entered service in 1954. These were the *Gornostaj* class (Table 17) and were single-deck, single-screw side trawlers with all-welded hulls, aft superstructure, and non-refrigerated holds. They fish for herring and bottom fish, storing them either heavily salted or in ice. In 1965 construction was begun on a large series of SRT's, the *Ajdar* class. These vessels are basically the same as the *Gornostaj* class, differing only in some items of equipment. None of these vessels is refrigerated and they are all steel-

**Table 12.—Type MRT trawlers.**

| Principal Particulars | MRT-17 | MRT-1026 | MRTR-12 |
|---|---|---|---|
| Country of building | Germany | Sweden | USSR |
| Year of building | 1943 | 1950 | 1967 |
| Length, o.a., m | 23.0 | 25.25 | 31.7 |
| Breadth, extreme m | 6.36 | 6.4 | 7.2 |
| Depth, m | 3.10 | 3.4 | 3.5 |
| Draft, m | 2.35 | 1.9 | 3.1 |
| Gross tonnage, reg. tons | 114 | 113 | 206 |
| Net tonnage, reg. tons | 30 | 25 | 63 |
| Deadweight, tons | 46 | 40 | 75 |
| No. nonrefrigerated cargo holds | 1 | 1 | None |
| Cubic capacity, $m^3$ | 48 | 65 | |
| No. refrigerated cargo holds | None | None | 1 |
| Cubic capacity, $m^3$ | " | " | 100 |
| Speed, knots | — | 8.5 | 9.2 |
| Engine type | Diesel | Diesel | Diesel |
| Refrigerant | None | None | Freon-12 |
| Temp. in refrigerated holds°C | " | " | -4°C |

**Figure 16.—A group of Soviet fishing vessels. On the extreme left is a *Nadeszhda* fishing boat of the type carried by the *Vostok*. The SRTM *Zheleznyakov* is on the extreme right. The vessel in the center *L-20* is probably an MRTR-class.**

hulled, two-masted, drifter/trawlers, with their machinery aft.

The first refrigerated medium trawlers in the Soviet Fleet (Soviet type designation SRTR) were the *Bologoe* class built in the Soviet Union in 1957. These side trawlers have basically the same principal particulars as the SRT trawlers (Table 18) but incorporate a Freon cooling plant which provides a fish room temperature of -2°C. The construction of *Bologoe* class trawlers continued up to 1963 and around 200 of them were built. Three ships of this class were the first Soviet trawlers to be fitted with c.p. propellers and the last vessel of the series, the *Progress*, was fitted with the first Soviet-built gas turbine/free piston gas generator propulsion installation. Some of these trawlers have been modernized by fitting equipment for purse-seine fishing and by installing bow thrusters. Another class of SRTR of this period, the *Okean* class, incorporated an ammonia refrigerating plant which provided a fish room temperature of from -2° to -4°C.

However the growing requirement to fish farther and farther away from the Soviet coasts accelerated the development of the medium freezer trawler (Soviet type-designation SRTM). The first two series of this trawler type, the *Mayak* and the *Pioneer* classes, were built in 1963. These new side trawlers were designed to work either independently or as part of a flotilla. They are able to be used for catching a wide variety of bottom and pelagic fish and herring, freezing and packing their catch in standard cardboard boxes, using drift or trawl nets from the starboard side. They are powered by a diesel engine developing 800 hp and driving a c.p. propeller.

These were not, however, the only freezer vessels built around this time. The building of freezer tuna fishing boats was begun, as part of the seven year plan, in 1962. These boats have basically the same principal particulars as the *Pioneer* but are designed to fish for tuna using either a long-line or troll gear in the near equatorial regions of the Pacific.

Fishing with the longline is carried out from both sides in the central area of the ship. The troll gear is intended for use during fish search operations. The captured tuna are killed with a humane killer and brought on deck, via a side port, by a boom crane with an electric winch. Here they are gutted and passed through to the freeze room where they are frozen to -18°C in blocks by four box-type blast freezers each with a capacity of 1 ton/day. Almost all the production processes are mechanized.

The processing plant can freeze 4 tons of fish per day. If the catch is greater than this, the excess is stored in flake ice and in a 2-ton capacity bunker. These boats are also able to deep-freeze high-vitamin content shark liver.

The refrigerating plant which supplies the freezing plant, refrigerated holds, ice-generator, and domestic air-conditioning system, consists of two ammonia two-stage compressors. The ship's storeroom is cooled by a Freon refrigeration plant.

The principal particulars of these vessels are:

| | |
|---|---|
| Length o.a. | 54.2 m |
| Breadth b.a. | 9.3 m |
| Depth, main deck | 4.7 m |
| Displacement, loaded | 930 tons |
| Draft, mean | 3.66 m |
| Deadweight | 322.5 tons |
| Power, main engine | 900 hp at 375 rpm |
| Speed | 11 knots |
| Capacities: | |
| Fuel | 222.0 tons |
| Lubricating oil | 7.5 tons |
| Fresh water | 52.3 t* |
| Provisions | for 50 days |

*Water requirement (calculated at 50-l per man per day) is provided by a desalination plant.

The USSR Register of Ships for 1964-65 lists some 816 SRT's (155

**Table 13.—RT-trawlers.**

| Principal Particulars | RT-56 | RT-61 | RT-168 | RT-180 | RT-200 | RT-212 |
|---|---|---|---|---|---|---|
| Country of building | Finland | Sweden | Sweden | Poland | Gt. Britian | Gt. Britain |
| Year of building | 1951 | 1952 | 1956 | 1954 | 1955 | 1957 |
| Length, o.a., m | 60.6 | 63.0 | 63.0 | 59.23 | 57.76 | 57.76 |
| Breadth, extreme, m | 9.02 | 9.03 | 9.3 | 9.0 | 9.75 | 9.75 |
| Depth, m | 4.85 | 4.85 | 4.85 | 4.9 | 5.03 | 5.03 |
| Draft, m | 4.19 | 4.29 | 4.29 | 4.33 | 4.52 | 4.52 |
| Gross tonnage, reg. tons | 645 | 744 | 689 | 658 | 684 | 685 |
| Net tonnage, reg. tons | 256 | 263 | 226 | 280 | 226 | 223 |
| Deadweight, tons | 410 | 415 | 455 | 455 | 335 | 365 |
| No. of nonrefrigerated cargo holds | 2 | 2 | 2 | None | None | None |
| Cubic capacity, $m^3$ | 267 111 | 219 141 | 259 155 | — | — | — |
| No. of refrigerated cargo holds | None | None | None | 2 | 2 | 2 |
| Cubic capacity, $m^3$ | — | — | — | 233 124 | 200 222 | 200 222 |
| Type of propulsion | Steam | Steam | Steam | Steam | Steam | Diesel |
| Speed, knots | 11 | 11 | 10.5 | 12 | 12.8 | 12.8 |
| Refrigerant | — | — | — | Freon-12 | Freon-12 | Freon-12 |
| No. of compressors | — | — | — | 1 | 1 | 1 |
| Temperature in refrigerated holds, °C | — | — | — | 2 × (-1°C) | 2 × (-1°C) | 2 × (-1°C) |

Figure 17.—The *Pioneer* RT class.

Figure 18.—*Stavrida*, a *Pioneer* class SRTM.

built in the Soviet Union, 660 built in East Germany, and 1 built in West Germany), 23 SRTM's (all built in the USSR), and 169 SRTR's (54 built in the USSR and 117 built in East Germany).

The first new Soviet-built medium trawlers to appear after 1966 were the *Olga* class SRTM (Table 19) and the *Sargassa* class SRTR (Table 18). The principal improvement on these vessels is the incorporation of gear required for fishing with a large purse-seine net (800 × 120 m on the name ship of the series and 1200 × 200 m on the remaining trawlers in the series). The net handling area is also extended. Some of the *Mayak* and *Pioneer* class SRTM's had been converted to purse-seine before this.

Table 14.—Type N1S-trawlers.

| Principal Particulars | N1S-5 |
|---|---|
| Country of building | USSR |
| Year of building | 1952 |
| Length, o.a., m | 39.49 |
| Breadth, extreme m | 7.40 |
| Depth, m | 3.60 |
| Draft, m | 2.98 |
| Gross tonnage, reg. tons | 335 |
| Net tonnage, reg. tons | 127 |
| Deadweight, tons | 174 |
| No. of nonrefrigerated cargo holds | 1 |
| Cubic capacity, $m^3$ | 103 |
| No. of refrigerated cargo holds | None |
| Cubic capacity, $m^3$ | — |
| Speed | 8.0 |
| Engine type | Diesel |
| Type of refrigerating plant | None |
| Refrigerant | — |
| No. of compressors | — |
| Temp. in refrigerated holds, °C | — |

## Vessels Entering The Fleet After 1965

Up to 1967 all Soviet medium trawlers had been side trawlers. The first medium stern trawler in the Soviet fleet was the SRTM *Zheleznyakov* (Table 20; Fig. 16) which was completed in 1967. The service performance of this vessel was carefully studied and a series of medium stern freezer trawlers were designed on the basis of the analysis of the performance and operation of the *Zheleznyakov*.

The first trawler of the new series was the SRTM *Zheleznyj Potok* (Table 20) which was built in 1968. Trawlers of this class are intended for operation in the temperate and tropical zones of the Atlantic, Pacific, and Indian Oceans and are equipped to fish with bottom and midwater trawl nets and purse-seine nets. They are able to operate independently or as part of an expeditionary fleet and to freeze and pack their own catch. They are also capable of operating as freezer/wet fish trawlers by stowing their most recent catch in flake ice.

In trawl fishing the catch is taken from the cod-end and placed in fish boxes arranged along the port side of the fish deck. A conveyor moves the fish to a four-section preparatory cooling bunker where the catch is chilled with flake ice. The fish are then passed automatically to the packing benches in the freeze room where they are packed in batches and moved on to the blast air freezer. The blocks of fish are frozen to a temperature of -18°C, glazed, and packed in cardboard boxes.

In purse-seine fishing the catch is placed in a fish box on the main deck between the superstructure and the trawl winch, from which it can be sent for freezing (in the freeze room) or to the fish-rooms for storage as wet fish.

The propulsion plant, aft, is a 8NVD48 AU diesel driving a c.p. propeller. The vessel's electricity requirement is supplied by four diesel generators with a rated output of 100kW. The steam requirement is met by an automatic auxiliary boiler of 0.5 tons/hr capacity.

The hull is strengthened for operation in ice and all accommodation, consisting of two- and one-berth cabins, is air-conditioned and located in the superstructure.

An improved version of the *Zheleznyj Potok* is now being produced (Table 20), which has increased propulsive power, an improved trawl winch, and is able to fish with a purse-seine net of 1200 × 200 m. The refrigerating and freezing plant capacities are also increased.

In recognition of the growing importance of seine fishing, the building of the name ship of a new series of SRTR's designed specifically as seine-trawlers was begun in 1969. This ship is the *Rumb* and is intended for expeditionary fleet operation. The principal particulars of the *Rumb* are:

**Table 15.—RS-type trawlers.**

| Principal Particulars | RS-1 | RS-854 | RS-5217 | RS-5308 |
|---|---|---|---|---|
| Country of building | USSR | USSR | East Germany | East Germany |
| Year of building | 1964 | 1958 | 1953 | 1958 |
| Length, o.a., m | 33.38 | 33.5 | 29.35 | 29.35 |
| Breadth, extreme m | 6.69 | 6.6 | 6.2 | 6.2 |
| Depth, m | 3.5 | 3.5 | 3.0 | 3.0 |
| Draft, m | 2.92 | 2.5 | 2.6 | 2.7 |
| Gross tonnage, reg. tons | 158 | 158 | 119 | 119 |
| Net tonnage, reg. tons | 39 | 40 | 32 | 32 |
| Deadweight, tons | 85 | 90 | 68 | 68 |
| No. of nonrefrigerated cargo holds | 2 | 1 | 1 | 1 |
| Cubic capacity, $m^3$ | 90.13 | 90 | 66 | 66 |
| No. of refrigerated cargo holds | None | None | None | None |
| Cubic capacity, $m^3$ | — | — | — | — |
| Engine type | Diesel | Diesel | Diesel | — |
| Speed, knots | 8.0 | 9.0 | 9.0 | 10 |
| Refrigerant | None | None | None | None |
| No. of compressors | — | — | — | — |
| Temp. in refrigerated holds, °C | — | — | — | — |

**Table 16.—SRS-trawler.**

| Principal Particulars | SRS-300 |
|---|---|
| Country of building | USSR |
| Year of building | 1962 |
| Length, o.a., m | 27.10 |
| Breadth, extreme m | 5.5 |
| Depth, m | 2.5 |
| Draft, m | 1.74 |
| Gross tonnage, reg. tons | 100 |
| Net tonnage, reg. tons | 31 |
| Deadweight, tons | 42 |
| No. of nonrefrigerated cargo holds | 1 |
| Cubic capacity, $m^3$ | 29 |
| No. of refrigerated cargo holds | None |
| Cubic capacity, $m^3$ | — |
| Speed | 8.9 |
| Engine type | Diesel |
| Refrigerant | None |
| No. of compressors | — |
| Temp. in refrigerated holds, °C | — |

**Table 17.—Medium trawlers (Soviet type-designation SRT).**

| | Ship and place of building | | | | |
|---|---|---|---|---|---|
| | East Germany | | | USSR | |
| Principal Particulars | SRT-300 without poop | SRT-300 | SRT-400 | *Korablestroitel* | *Gernostaj* and *Ajdar* |
| Length, m | 38.5 | 38.5 | 39.15 | 38.64 | 39.15 |
| Breadth, m | 7.2 | 7.3 | 7.3 | 7.4 | 7.3 |
| Depth, to main deck, m | 3.5 | 3.5 | 3.48 | 3.85 | 3.49 |
| Draft, loaded, m | 3.57 | 3.57 | 3.12 | 3.15 | 3.0 |
| Displacement, loaded, tons | 436 | 436 | 452 | 467 | 432 |
| Deadweight, tons | 187 | 140 | 145 | — | 141 |
| Propulsion machinery | Diesel with fixed-pitch propeller | | | | |
| Main engine, hp | 300 at 360 rpm | 300 at 360 rpm | 400 at 275 rpm | 400 at 400 rpm | 300 at 360 rpm |
| Supplies, | | | | | |
| fuel, tons | 38 | 46 | 54 | — | 54 |
| water, tons | 24 | 31 | 28 | — | 28 |
| Speed, knots | 9-10 | 9.5 | 10.3 | 9.2 | 9.6 |
| Endurance, days | 25 | 25 | 25 | 25 | 25 |
| Crew | 26 | 22 | 25 | 29 | 25 |

| | |
|---|---|
| Length o.a. | 49.2 m |
| Length b.p. | 46.2 m |
| Breadth | 10.5 m |
| Depth, main deck | 6.0 m |
| Displacement, max | 1,130 tons |
| Draft, at above | 4.24 m |
| Capacity, refrigerated holds | 318 $m^3$ |
| Power, main engine (geared diesel with c.p. propeller) | 1,320 hp at 428 rpm |
| Propeller rpm | 250 |
| Power, electric plant: | |
| Diesel generator | 450 kW |
| Shaft generator | 300 kW |
| Capacity, refrigerating plant | 110,000 k cal/hr |
| Fish room temperature | -5°C |
| Fishing gear | stern trawl, and purse-seine measuring 1,300 × 300 m |
| Pull, trawl winch | 10.0 tons |
| Speed, taking in trawl warps | 100 m/min |
| Endurance | 35 days |
| Complement | 23 |
| Range | 9,000 miles |

Later ships in this series will have their speed increased to 19 knots.

### Catamaran Trawlers

A unique vessel which does not fit into the vessel type classification used hitherto is the twin-hulled trawler/seiner *Experiment*. This vessel, which was constructed at Kaliningrad in 1968, was a cooperative design venture by the Central Design Bureau of the Ministry in Moscow, the Kaliningrad Technical Institute for Fisheries and Fishing, and the Design Bureau of ATLANTniro. As its name implies, it is an experimental vessel and is the first of a program of three or four twin-hulled vessels being undertaken to evaluate their operational advantages over single-hulled ships.

It was decided, as the optimal solution to the design problem, to use modified conventional SRT 300 hulls (Table 17) and to connect them by a rigid cross-structure. The depth of the cross-structure was selected to reduce wave impacts. The upper edge of the cross-structure is at deck level and it is carried to a depth of 1,200 mm at ship side and 700 mm at the center.

The DTS *Experiment* (Fig. 19) is a twin-hulled, single-deck vessel with a rounded stem and stern ramp in each hull. Each hull is subdivided by six transverse watertight bulkheads. The aft sections of the cross-structure are used as fuel tanks.

All accommodation, service, and public compartments are grouped in the two-tier superstructure above the upper deck. A centralized wheelhouse, giving all-around observation, is located on top of the after part of the superstructure. The accommodation consists entirely of one- and two-berth cabins, each of which is electrically heated and fitted with washbasins and hot and cold water. The galley is all-electric and there are separate messes for officers and crew. Laboratories for strength testing and seakeeping investigations are also incorporated.

The DTS is fitted with two individually controlled streamlined rudders with electrically powered steering gear. The main machinery is automated with controls in the wheelhouse and on the bridge wings. The propulsion machinery consists of two diesel engines (one in each hull) each developing 300 hp at 360 rpm directly coupled to its propeller. The electric power plant consists of two diesel generators, each of 100 kW in the starboard engine room and one diesel generator of 57 kW in the port engineroom all at 220 V DC.

**Table 18.—Soviet-built SRTR's.**

| Principal Particulars | *Bologoe* | *Sargassa* |
|---|---|---|
| Length, o.a., m | 43.6 | 54.2 |
| Length, b.p., m | 39.6 | 48.7 |
| Breadth, m | 7.6 | 9.3 |
| Depth, main deck, m | 3.8 | 4.7 |
| Displacement, max. tons | 550.0 | 1,000 |
| Draft at above, m | 2.96 | 3.82 |
| Capacity refrigerated fish rooms, m³ | 215.0 | 420 |
| Type of propulsion | Diesel with fixed or c.p. propeller | Diesel with c.p. propeller |
| Power main engine, hp | 400 hp at 275 rpm | 800 hp at 300 rpm |
| Overall power electric plant, kW | 87.0 | 300 |
| Trawl gear | side trawl and drift nets | Side trawl, purse-seine |
| Fish room temperature °C | −2 | −5 |
| Pull, trawl winch, tons | 4.0 | 6/8 |
| Speed of taking in the trawl warps, m/min | 60 | 60/45 |
| Endurance, days | 30 | 30 |
| Speed, knots | 10.4 | 11.7 |
| Complement | 26 | 29 |
| Range, miles | 7,500 | 9,000 |
| Area of operation | ---------- Unlimited ---------- | |
| Capacity, refrigerating plant k cal/hr | — | 200,000 |

**Table 19.—Soviet-built SRTM's (side trawling).**

| Principal Particulars | *Mayak* | *Pioneer* | *Ol'ga* |
|---|---|---|---|
| Length, o.a., m | 54.2 | 54.2 | 45.2 |
| Length, b.p., m | 48.7 | 48.7 | 48.7 |
| Breadth, m | 9.3 | 9.3 | 9.3 |
| Depth, main deck, m | 4.7 | 4.7 | 4.7 |
| Displacement, max. tons | 935 | 900 | 975 |
| Draft at above, m | 3.69 | 3.57 | 3.76 |
| Capacity refrigerated fish room, m³ | 350 | 290 | 290 |
| Power main engine (Diesel with c.p. propeller) hp | 800 to 300 rpm | 800 at 300 rpm | 800 at 300 rpm |
| Overall power electric plant, kW | 300 | 264 | 300 |
| Refrigerating plant capacity kcal/hr | 76,000 | 76,000 | 76,000 |
| Fish room temperature, °C | −18 | −18 | −18 |
| Freezing plant capacity, tons/day | 6 | 12 | 12 |
| Gear | Drift net | tuna, longline purse-seine | |
| Type of pull of trawl winch, (tons) | — | LETr-3(6/8) | — |
| Speed of taking in the trawl warps m/min | 60/45 | 60/45 | 60/45 |
| Endurance, days | 30 | 30 | 30 |
| Speed | 12 | 12 | 11.7 |
| Complement | 29 | 29 | 29 |
| Range, n. miles | 9,000 | 9,000 | 9,000 |
| Area of operation | ---------- Unlimited ---------- | | |

The principal particulars of the *Experiment* are:

| | |
|---|---|
| Length o.a. | 39.7 m |
| Length waterline | 37.4 m |
| Beam o.a. | 19.08 m |
| one hull | 7.3 m |
| Depth | 4.08 m |
| Draft, load line | 3.0 m |
| Displacement, at above | 950 tons (approx) |
| $C_B$, one hull | 0.56 |
| Power, main engine | 2 × 300 hp |
| Speed, in still water | 9.0 knots |
| Endurance | 27 days |
| Complement | 32 |
| Extra accommodation for scientific personnel | 6 berths |
| Capacity, cargo holds | 450 m³ (total) |

The vessel's steam requirement is met by an automated boiler with a capacity of 0,5 ton/hr located in the port engine room.

The design provides for fishing by bottom and midwater trawls using a constant trawling system with a time lag of 3 min between hauling in the first trawl and shooting the second, purse-seine (changing from trawling to purse-seining does not take more than one hour). The vessel is fitted with a trawl warp winch, two bridle winches, a special winch for traversing the hanging blocks, and an arrangement of roller fairleads for the warps. The arrangement for purse-seine fishing consists of two power blocks at the crosstrees of the duopod mast.

Model tests were conducted before construction was begun, using a scale 1:15 model in a test tank, and a self-propelled 1:85 scale model (with a man on board) in open water. Rolling and pitching amplitudes and the accelerations and dynamic pressures acting on the cross structure due to wave impacts were measured on the large-scale model.

The main trials of the *Experiment* were conducted in the winter months in the Baltic and North Atlantic. The trial voyage lasted 59 days, of which 26 were spent in storm conditions, and the vessel operated in sea conditions of force 10 or greater on three occasions. Investigations carried out during trials showed that the cross-structure provides sufficient strength to be used in any seas or sea state.

Since trials the *Experiment* has completed two transatlantic fishing expeditions and, despite the fact that it was operating experimentally, its catch significantly exceeded that of neighboring trawlers working in the vicinity. No difficulty was experienced in mooring alongside factory/depot ships at sea.

From experience gained in the operation of the *Experiment*, the catamaran hull-form is found to be particularly suitable for a number of different types of fishing vessels and fishing methods. Its principal advantages are a high degree of stability under way, low rolling amplitudes, minimal deck wetness, high maneuverability, increased working deck space (Table 21), improved accommodation and working conditions, and an ability to fish from more than one stern ramp.

**Table 20.—Soviet-built SRTM's (stern trawling).**

| Principal Particulars | *Zhelezhyakov* | *Zheleznij Potok* | Improved Design of *Zheleznij Potok* |
|---|---|---|---|
| Length, o.a., m | 54.8 | 54.8 | 54.8 |
| Length, b.p., m | 49.4 | 49.4 | 49.4 |
| Breadth, m | 9.8 | 9.8 | 9.8 |
| Depth, main deck, m | 5.0 | 5.0 | 5.0 |
| Displacement, max. tons | 1,080 | 1,130 | 1,150 |
| Capacity refrigerated fish rooms, m³ | 383 | 400 | 414 |
| Power main engine (Diesel with c.p. propeller) hp/rpm | 800 at 300 rpm | 1,000 at 375 rpm | 1,318 at 428 rpm |
| Overall power electric plant, kW | 300 | 400 | 500 |
| Capacity refrigerating plant at an evaporation temperature of 40°C, k cal/hr | 76,000 | 114,000 | 150,000 |
| Fish room temperature, °C | −6; −18 | −6; −18 | −6; −24 |
| Freezing plant capacity, tons/day | 12 | 12 | 20 |
| Trawl gear | Purse-seine 640 × 120 m | | Purse-seine 1200 × 200 m |
| Remote-controlled trawl winch, type | LETr-3 | LETr-3 | LTE-6.3 |
| Pull of trawl winch, tons | 6/8 | 6/8 | 6.3/8 |
| Speed of taking in the trawl warps, m/min | 60/45 | 60/45 | 90/70 |
| Endurance, days | 30 | 30 | 30 |
| Speed, knots | 11.7 | 12.0 | 13.0 |
| Complement | 29 | 29 | 29 |
| Area of operation | ---------- Unlimited ---------- | | |

Figure 19.—The experimental twin-hulled trawler/seiner *Experiment*.

## FOREIGN RELATIONS

The worldwide operation and domestic importance of the Soviet fishing industry have made it an important part of Soviet foreign policy in general and of its aid program to developing countries in particular.

The USSR takes an active role in all international bodies for the regulation, control, or conservation of fisheries. In addition the Soviet Union has conducted a policy of negotiating directly with individual coastal states for fishing/landing rights in particular ocean areas and a multitude of such agreements now exist between the USSR and the United States, Canada, Japan, and other countries.

In the case of developing nations, the fishing industry has played a vital role in the USSR's assistance program and generous help has been given to develop local fishing industries in return for particular offshore fishing/landing rights. An example of this mutual help policy is the northwest African fishery where generous help from the USSR encouraged the rapid development of the domestic fishing industries in Ghana and Senegal. As a result these two countries produce the largest catches in West Africa. Of the 42 countries (including Japan) fishing in this ocean area, the largest catch is taken by the USSR with Senegal and Ghana taking second and third place respectively.

The dramatic increase in the USSR's catch in the Indian Ocean has also been in parallel with Soviet-aided fishery development projects in India and Ceylon.

Another aspect of the Soviet aid program is the export of fish products. Although by far the greater part of the Soviet catch is intended for domestic consumption, a small proportion is exported (Table 22) and almost all of this is delivered to other socialist states. Some, however is exported to developing nations like Egypt and Ghana where it can make some contribution towards meeting the shortfall in the receiving nations' animal protein requirement.

Other aid programs have been the building of shore facilities, for example of a shipyard in Egypt and the construction of a fishing port, fish dock, and other facilities in Cuba.

Through this aid program to help developing nations to meet the basic and fundamental task of feeding their populations, the Soviet fishing industry has become a powerful and effective instrument for increasing and extending Soviet influence and interests throughout the world.

**Table 21.—Comparison of working deck area and displacement of different types of trawlers.**

| Trawler type | Working deck area, $m^3$ | Displacement, tons |
|---|---|---|
| SRTR *Bologoe* | 125 | 457 |
| SRTM *Mayak* | 200 | 950 |
| RTM *Tropik* | 230 | 2,800 |
| BMRT *Mayakovskij* | 300 | 3,600 |
| DTS *Experiment* | 440 | 950 |

## FUTURE DEVELOPMENT

The present five-year plan for the industry has set a catch target of 10.0 million metric tons by 1975. This means that in the years 1971 to 1975 the USSR must increase its catch from all sources by an average of 665.5 thousand metric tons per annum, whereas the average annual increase from 1965 to 1970 was only 430.46 thousand metric tons. The increase over the 1970 catch in 1971 was only 84.5 thousand metric tons and the maximum annual increase over the period under discussion was 753.8 thousand metric tons in 1970. Overall the fish and shellfish catch actually attained in 1970 fell short of the target set in 1965 by about 500 thousand metric tons.

In the broader context, the rate of increase in the world catch appears to be slowing down despite estimates of a possible world catch of around 100 million metric tons. The year 1969 saw the first drop in the world catch (from 63.9 million metric tons in 1968 to 62.6) since the end of World War II. This figure was further reduced to 62.4 million metric tons in 1971.

Over this period the USSR has managed to maintain its catch at a fairly consistent 11 percent of the world total. However it has not succeeded in closing the gap between its own catch and that of its closest competitor, Japan, a gap which has increased from 2 million metric tons in 1967 to 2.5 million metric tons in 1971. In this latter year the Japanese fleet comprised 2,578 vessels of all kinds over 100 grt compared with the USSR's 3,563.

In common with all the other fishing nations of the world the USSR is, therefore, suffering from increased international competition and effort in both traditional and newly-established fishing grounds. In addition the current international trend of coastal states to extend, unilaterally, their fishing limits from the internationally accepted 12 miles to up

Table 22.—USSR exports and imports of fish and fish products, 1968-71.

| Product | Imports | | | | Exports | | | |
|---|---|---|---|---|---|---|---|---|
| | 1968 | 1969 | 1970 | 1971 | 1968 | 1969 | 1970 | 1971 |
| Fish: fresh, chilled, or frozen | 26.1 | 29.1 | 38.2 | 22.2 | 183.7 | 165.9 | 222.2 | 261.1 |
| Fish: dried, salted, or smoked | 7.6 | 3.2 | 0.1 | — | 24.2 | 23.0 | 21.4 | 16.1 |
| Fish: canned or packaged | 1.4 | 1.7 | 1.5 | 1.4 | 20.1 | 22.1 | 22.4 | 22.1 |
| Shellfish products | — | — | — | — | 4.7 | 3.4 | 3.8 | 3.5 |
| Oil and fats | 0.3 | 0.0 | 0.1 | 0.0 | 59.4 | 64.0 | 34.5 | 14.6 |
| Meal and animal feedstuffs | 53. | 0.6 | — | — | 28.0 | 26.5 | 12.1 | 10.4 |
| Total | 40.7 | 34.6 | 39.9 | 23.8 | 320.1 | 304.9 | 316.4 | 327.8 |

to 200 miles and more is forcing foreign fleets off the continental shelf from which the overwhelming majority of the world's catch is taken. In view of this it seems increasingly unlikely that the industry will achieve its target by 1975.

Since 1946, the USSR has adopted a policy of continued expansion of its fleet and area of operation. This is a process which cannot be continued indefinitely, not only because there are a finite number of fish in the sea, but also because the increased competition in the available grounds will make the large fleets used at present counterproductive. In addition, labor productivity is significantly less in the Soviet fleet than in its nearest competitors (as is shown by the comparison between the Japanese and Soviet catches and fleet sizes made above), and it is obviously essential, in view of the current situation in world fisheries, to increase fishing effort by greater efficiency rather than solely by greater investment in catching units. If the Soviet fleet is in fact able to increase the productivity of its industry to a level comparable with its competitors, this will, in itself, tend to reduce the number of units operated. As far as present commercially exploited stocks are concerned it is highly probable that the optimal catch in terms of resource viability and economic fishing effort will be attained within the very near future. This means that other fish species, hitherto considered unsuitable or uneconomic to fish, will have to be exploited, which in turn requires the design and development of new vessels, gear, and food products.

Such species fall into two main groups: pelagic species inhabiting the deep oceans and demersal fish at depths in excess of 1,000 m, and it is to exploit these new species efficiently that the Soviet R and D organization is now directed. In terms of objectives the Soviet industry must seek to:

1) Increase the catch of pelagic fish from the deep-water areas of the world's oceans by improving fish-finding and herding techniques and equipment, improving the design of vessels for autonomous operation, improving net-gears like seines and midwater trawls, and developing new non-net catching methods involving the use of electricity, pumps, underwater light, noises, etc, either singly or in combination.

2) Increase the fleet's deep-water trawling capability to 2,000 m and more by developing new fish-finding equipment, winches, warps, trawls and other gear.

3) Increase the production of fish meal and associated products by exploiting underutilized species in traditional and new fishing grounds and to develop new food products which can make former "industrial" fish more attractive to the human consumer.

4) Increase fish-farm production in both fresh and seawater.

Significant developments have and are being made in all these areas as the introduction of self-contained special purpose fish/fish meal factory trawlers like *Pos'et*, *Altaj* and *Gorizont*, and self-contained mother ships like *Vostok*, and the introduction of new net and non-net methods of deep-water and midwater fishing show.

So, although it does seem inevitable that the proportion of the total protein requirements of the USSR provided by the industry will fall, the industry will continue to be a vital part of the country's food production industry through its ability to exploit new fish resources and to increase fish production through cultivation.

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MFR PAPER 1076

*Japan's frozen shrimp imports have increased steadily since 1966.*

# Japan's Frozen Shrimp Imports: 1973

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## INTRODUCTION

Japan imported 117,474 metric tons of frozen shrimp worth US$436 million in 1973. This represents a 33 percent increase in quantity and a 49 percent increase in value over 1972 imports. Table 1 shows the steady increases in Japan's shrimp imports since 1960.

Japan's shrimp imports in 1973 followed monthly import patterns set in previous years, albeit on a much higher scale, both in quantity and in value. The year began with sharply reduced imports after heavy year-end purchases in late 1972. During the second quarter imports generally increased, followed by a slack during the third quarter. During the last quarter, however, imports increased dramatically as Japanese traders began making heavy purchases designed to provide them with ample stocks for New Years celebrations when the Japanese public consumes an enormous amount of this seafood delicacy.

Of special note is the 13,307 metric tons imported in October 1973, the highest monthly importation of shrimp on record. Also noteworthy is the steady growth of imports since 1970-71. Figure 1 provides a clear display of Japan's monthly imports of frozen shrimp, both by quantity and by value, for the period 1967-73. The graph clearly shows the increasing trend of imports during this seven-year period, and it also suggests the future direction of Japanese imports of frozen shrimp.

India was Japan's principal supplier of frozen shrimp in 1973 with 21,903 tons, regaining the lead from Indonesia which came in second with 18,764 tons. Thailand's exports of 9,884 tons ranked that country third. Mexico was fourth in 1973 with 8,839 tons, replacing Malaysia whose shrimp exports in 1973 were 6,537 tons.

Table 2 provides detailed statistics on Japan's monthly shrimp imports by region and by country. U.S. seafood dealers will find it useful to note when Japanese shrimp importers are most active in a particular country. The list and subsequent statistics may also provide U.S. importers with potentially new areas for supplies of shrimp.

As shown in Table 2 the countries of Southeast Asia are Japan's main

**Table 1.—Japan's frozen shrimp imports, 1960-73.**

| Year | Value | Quantity[4] |
|---|---|---|
| | *US$1,000* | *Kilograms* |
| 1973 | 436,322[1] | 117,474,000[5] |
| 1972 | 291,944[1] | 88,120,260[6] |
| 1971 | 214,598[1] | 78,874,006[6] |
| 1970 | 137,025[2] | 57,145,972[6] |
| 1969 | 121,748[2] | 48,885,788[6] |
| 1968 | 78,079[2] | 35,203,692[6] |
| 1967 | 79,732[2] | 44,465,669[6] |
| 1966 | 60,085[2] | 36,156,000[6] |
| 1965 | 35,938[2] | 21,011,000[6] |
| 1964 | 31,437[2] | 17,087,000[6] |
| 1963 | 23,470[3] | 11,708,000[7] |
| 1962 | 6,169[3] | 3,642,000[7] |
| 1961 | 6,970[3] | 4,058,000[7] |
| 1960 | 652[3] | unavailable |

[1]Based on monthly custom clearance declarations in the "Foreign Fishery Information Releases," owing to wide fluctuations in Japanese yen values (360 yen:US$1, 1971; 263: US$1, 1972; and up to 300:US$1, 1973).
[2]Source: *Japan Exports and Imports, Commodity by Country*. Based on 360 yen:US$1.
[3]Source: Fisheries Statistics of Japan, 1969.
[4]Heads-off weight.
[5]Source: Japanese fishery newspapers.
[6]Source: *Japan Exports and Imports, Commodity by Country* (considered official).
[7]Source: Japanese trade publications.

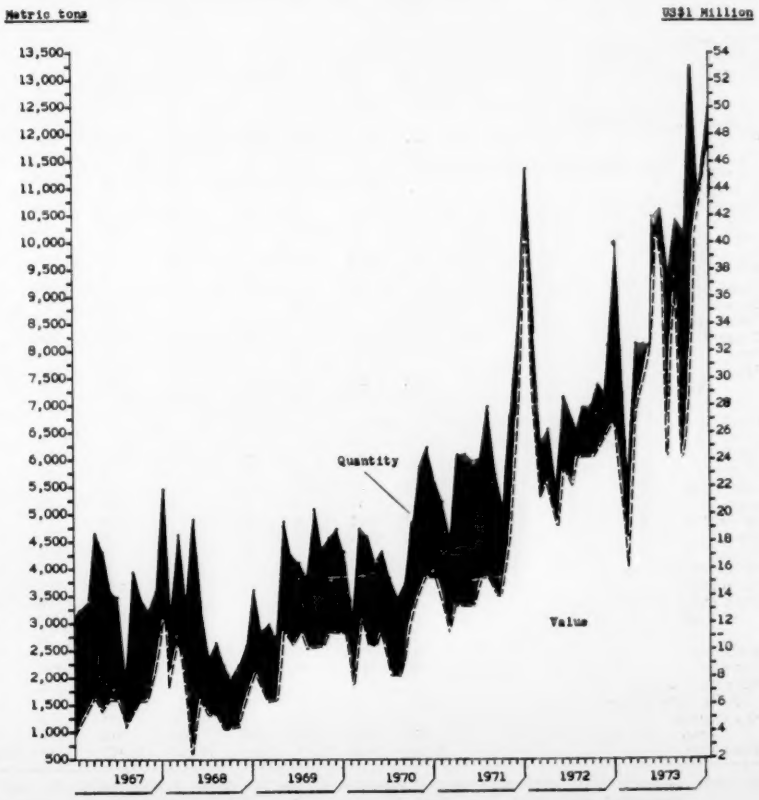


**Figure 1.—Quantity and value of Japan's monthly frozen shrimp imports (1967-73).**

**Table 2.—Japan's monthly imports of frozen shrimp, by region, country, and by quantity, 1973.**

| Region and Country | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast Asia | | | | | | | | | | | | | |
| South Korea | 47 | 56 | 47 | 87 | 109 | 207 | 256 | 345 | 211 | 450 | 463 | 293 | 2,571 |
| North Korea | 1 | 9 | 3 | — | 10 | 29 | — | 5 | — | 14 | 16 | 2 | 90 |
| Mainland China | 369 | 377 | 892 | 508 | 193 | 63 | 141 | 103 | 230 | 465 | 301 | 832 | 4,475 |
| Taiwan | 344 | 234 | 230 | 329 | 223 | 157 | 363 | 387 | 709 | 675 | 605 | 784 | 5,040 |
| Hong Kong | 65 | 110 | 143 | 239 | 284 | 241 | 314 | 218 | 437 | 336 | 383 | 281 | 3,052 |
| S. Vietnam | 107 | 84 | 116 | 150 | 10 | — | — | — | — | — | — | 195 | 662 |
| Thailand | 406 | 800 | 689 | 925 | 1,010 | 898 | 766 | 838 | 669 | 1,280 | 908 | 696 | 9,884 |
| Singapore | 13 | 12 | 37 | 52 | 44 | 111 | 56 | 185 | 6 | 74 | 93 | 146 | 831 |
| Malaysia: | | | | | | | | | | | | | |
| West Malaya | 164 | 224 | 278 | 312 | 650 | 440 | 896 | 659 | 416 | 442 | 412 | 299 | 5,190 |
| Sarawak | 10 | 8 | 25 | 7 | 39 | 51 | 47 | 43 | — | 123 | 9 | 11 | 373 |
| Sabah | 26 | 183 | 128 | 69 | 138 | 139 | 68 | 140 | 73 | 162 | 106 | 115 | 1,347 |
| Total | 200 | 415 | 431 | 388 | 827 | 630 | 1,011 | 842 | 489 | 727 | 527 | 425 | 6,910 |
| Philippines | 101 | 146 | 149 | 110 | 115 | 137 | 181 | 208 | 215 | 305 | 379 | 234 | 2,281 |
| Indonesia | 757 | 1,458 | 1,299 | 1,157 | 2,029 | 1,365 | 1,629 | 1,605 | 1,159 | 1,810 | 1,774 | 2,720 | 18,764 |
| Cambodia | — | — | — | — | — | — | — | — | — | 8 | 6 | — | 14 |
| India | 1,237 | 1,832 | 1,540 | 1,592 | 1,811 | 2,301 | 1,081 | 1,621 | 1,936 | 2,958 | 2,143 | 1,850 | 21,903 |
| Pakistan | 587 | 454 | 437 | 229 | 152 | 466 | 106 | 164 | 140 | 352 | 489 | 653 | 4,231 |
| Bangladesh | — | — | 28 | 14 | 93 | — | 15 | 9 | 11 | 137 | 176 | 145 | 628 |
| Sri Lanka (Ceylon) | 4 | 2 | — | 37 | 18 | 77 | 9 | 31 | 32 | 35 | 3 | — | 249 |
| Macao | 7 | 7 | 5 | — | 4 | 9 | — | 10 | — | 13 | 22 | — | 76 |
| Burma | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| Total | 4,245 | 5,996 | 6,046 | 5,817 | 6,932 | 6,691 | 5,928 | 6,571 | 6,244 | 9,639 | 8,288 | 9,258 | 81,663 |
| Middle East | | | | | | | | | | | | | |
| Iran | 225 | — | — | — | 135 | — | 2 | 396 | — | — | — | 100 | 859 |
| Bahrain | 153 | 92 | 84 | 118 | — | 37 | 132 | — | 392 | — | 176 | 264 | 1,447 |
| Yemen, South | — | — | — | — | — | — | — | — | — | — | — | — | — |
| Saudi Arabia | — | 70 | — | 36 | — | — | 9 | — | — | 212 | — | — | 327 |
| Kuwait | 1 | — | — | 24 | 37 | 312 | 198 | 139 | — | — | 56 | — | 768 |
| Trucial Oman & Qatar | 9 | 28 | — | 56 | 25 | 5 | — | 136 | 80 | — | 42 | — | 381 |
| Yemen | — | 45 | — | — | — | — | 29 | — | — | — | — | — | 74 |
| Total | 388 | 235 | 84 | 234 | 197 | 354 | 370 | 671 | 472 | 212 | 274 | 364 | 3,856 |
| Europe | | | | | | | | | | | | | |
| Netherlands | — | — | — | — | — | — | — | — | — | — | — | 14 | 14 |
| Iceland | — | — | — | — | — | — | — | — | — | 1 | — | — | 1 |
| Soviet Union | 322 | — | — | 2 | 299 | 152 | — | 764 | 1,420 | 1,647 | 638 | 898 | 6,141 |
| Norway | — | — | — | — | — | 1 | 5 | — | — | — | — | — | 6 |
| West Germany | — | — | — | — | — | — | — | — | 8 | — | — | — | 8 |
| Total | 322 | — | — | 2 | 299 | 153 | 5 | 764 | 1,428 | 1,648 | 638 | 912 | 6,169 |
| North America | | | | | | | | | | | | | |
| Canada | — | — | — | — | 13 | 3 | — | 26 | — | 1 | — | — | 44 |
| United States | 5 | 38 | — | 100 | 132 | 141 | 51 | 66 | 14 | 4 | 15 | 69 | 636 |
| Total | 5 | 38 | — | 100 | 145 | 144 | 51 | 92 | 14 | 5 | 15 | 69 | 680 |
| Latin American & Caribbean | | | | | | | | | | | | | |
| Mexico | 444 | 1,177 | 1,466 | 1,160 | 1,178 | 725 | 908 | 333 | 369 | 98 | 184 | 796 | 8,839 |
| Guatemala | — | — | — | — | 44 | 5 | 8 | 6 | — | — | — | — | 85 |
| Honduras | — | — | — | — | 9 | 17 | 9 | 23 | — | 1 | 21 | — | 58 |
| El Salvador | — | — | — | 17 | 36 | 24 | 45 | 84 | 61 | — | 1 | — | 268 |
| Nicaragua | — | — | — | — | — | — | — | 37 | — | — | 4 | — | 41 |
| Panama | — | — | — | 19 | 12 | 20 | 37 | 12 | — | 27 | — | — | 128 |
| Trinidad & Tobago | — | — | 7 | — | 34 | 44 | 26 | 115 | 25 | 28 | 8 | 13 | 301 |
| Cuba | 77 | 63 | 49 | — | 280 | 121 | — | — | 315 | 186 | 391 | 392 | 1,985 |
| Colombia | — | — | — | 26 | 25 | 53 | 41 | 43 | — | — | — | — | 188 |
| Venezuela | — | 109 | — | 125 | 7 | 115 | 156 | — | 9 | 199 | 123 | 38 | 882 |
| Guyana | 13 | — | 46 | — | 26 | 125 | 97 | 241 | 84 | 143 | — | 74 | 850 |
| French Guiana | — | — | — | — | — | 34 | 24 | — | — | — | — | — | 58 |
| Ecuador | — | 4 | — | 123 | 16 | 197 | 106 | 76 | 37 | 8 | — | — | 567 |
| Peru | — | 23 | 10 | — | 24 | — | 30 | — | — | — | 6 | — | 94 |
| Brazil | — | 16 | 20 | 26 | 320 | 203 | 83 | 122 | 239 | 71 | 44 | 51 | 1,196 |
| Total | 534 | 1,392 | 1,598 | 1,496 | 2,011 | 1,683 | 1,570 | 1,092 | 1,139 | 761 | 782 | 1,364 | 15,540 |
| Africa | | | | | | | | | | | | | |
| Dahomey | — | — | — | — | — | — | — | — | — | — | — | 21 | 21 |
| Senegal | — | — | — | — | — | — | 14 | 1 | 23 | — | 24 | — | 62 |
| Liberia | 31 | 5 | 20 | 20 | 15 | 19 | — | 33 | 125 | 38 | 53 | 115 | 475 |
| Ivory Coast | 10 | 18 | 25 | — | — | 56 | 80 | — | 71 | — | — | 5 | 265 |
| Nigeria | — | 17 | 7 | 6 | 6 | 96 | 26 | 26 | — | 15 | 96 | 79 | 375 |
| Cameroons | 24 | 83 | 29 | 72 | — | 95 | — | 127 | 102 | 117 | 116 | — | 768 |
| Angola | — | — | — | — | — | 3 | — | — | — | — | — | — | 3 |
| Kenya | — | — | — | — | — | — | — | — | — | — | 17 | — | 17 |
| Mozambique | — | 36 | 19 | — | — | — | 45 | — | 39 | 59 | 5 | 5 | 208 |
| Madagascar | — | 52 | 35 | 43 | 267 | 375 | 280 | 279 | 81 | 120 | 140 | — | 1,673 |
| South Africa | — | — | — | — | — | — | 12 | — | — | 20 | 39 | 37 | 108 |
| Total | 65 | 211 | 135 | 141 | 288 | 644 | 457 | 466 | 441 | 369 | 490 | 790 | 3,975 |
| Australasia | | | | | | | | | | | | | |
| Australia | 91 | 103 | 58 | 185 | 632 | 923 | 859 | 666 | 231 | 484 | 302 | 235 | 4,769 |
| Papua/New Guinea | — | 5 | — | — | 9 | 22 | 102 | — | 66 | 156 | — | 18 | 378 |
| Trust Ter. New Guinea | — | — | — | — | — | — | 14 | — | — | — | — | — | 14 |
| New Zealand | 10 | 15 | 24 | 5 | 18 | 14 | 3 | 31 | 151 | 32 | 28 | 99 | 430 |
| Total | 101 | 123 | 82 | 190 | 659 | 959 | 978 | 697 | 448 | 672 | 330 | 352 | 5,591 |
| Grand total | 5,658 | 7,995 | 7,947 | 7,981 | 10,557 | 10,627 | 9,359 | 10,352 | 10,185 | 13,307 | 10,816 | 13,109 | 117,474 |

SOURCE: Statistics were obtained from the Japanese fishery newspaper *Suisan Keizai Shimbun*. These figures are published monthly and are considered preliminary. Also, many figures have been rounded and as a result many of the total figures do not agree with statistical figures provided each country. The figures, however, provide a reasonable approximation of Japan's monthly imports by country.

suppliers of shrimp. The next most significant region is Latin America with Mexico being the most important single supplier. Among European nations the Soviet Union increased its exports of shrimp to Japan from 2,576 tons in 1972 to 6,141 tons in 1973. For the first time exports of shrimp from Norway, Iceland, and West Germany were made to Japan. In Africa, Madagascar remained Japan's most important supplier of shrimp, but this situation may not last long. Political pressures are mounting to remove the strong Japanese influence in that country's fisheries.

Tables 3 and 4 provide statistical tabulations on Japan's monthly imports of frozen shrimp by quantity and value respectively. With the statistical data in these two tables, seafood dealers may be able to estimate approximate quantities and prices for Japan's shrimp imports during 1974, thus allowing them to plan their own purchases in the face of Japan's increasing competition for world supplies of shrimp.

**Table 3.—Japan's monthly[1] imports of frozen shrimp, by quantity, 1967-73.**

| Month | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 |
|---|---|---|---|---|---|---|---|
| | | | | *Metric tons* | | | |
| January | 3,240 | 3,392 | 2,884 | 3,112 | 5,291 | 8,301 | 5,658 |
| February | 3,374 | 4,611 | 2,956 | 4,767 | 4,671 | 6,439 | 7,995 |
| March | 4,619 | 3,300 | 2,779 | 4,614 | 6,143 | 6,681 | 7,947 |
| April | 4,311 | 2,507 | 4,817 | 4,123 | 6,100 | 5,568 | 7,981 |
| May | 3,604 | 3,215 | 4,232 | 6,472 | 5,975 | 7,253 | 10,557 |
| June | 3,589 | 2,324 | 4,122 | 3,871 | 6,095 | 6,653 | 10,626 |
| July | 2,065 | 2,649 | 3,832 | 3,579 | 7,022 | 7,157 | 9,359 |
| August | 3,908 | 2,233 | 5,194 | 3,797 | 5,764 | 7,131 | 10,352 |
| September | 3,451 | 2,022 | 4,404 | 4,868 | 5,101 | 7,431 | 10,185 |
| October | 3,247 | 2,496 | 4,630 | 5,980 | 6,808 | 7,321 | 13,307 |
| November | 3,601 | 2,853 | 4,726 | 6,283 | 8,471 | 8,175 | 10,816 |
| December | 5,452 | 3,606 | 4,306 | 5,675 | 11,429 | 10,007 | 13,109 |
| Total | 44,461 | 35,204 | 48,886 | 57,146 | 78,874 | 88,120 | 117,474 |

[1]Monthly figures do not add to official statistics for each year.

**Table 4.—Japan's monthly[1] imports of frozen shrimp, by value, 1967-73.**

| Month | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 |
|---|---|---|---|---|---|---|---|
| | | | | *US$1,000* | | | |
| January | 4,655 | 7,623 | 7,000 | 7,933 | 13,202 | 28,837 | 16,617 |
| February | 5,666 | 10,291 | 6,791 | 12,053 | 11,517 | 21,305 | 27,429 |
| March | 6,519 | 7,775 | 6,468 | 10,794 | 13,783 | 22,435 | 27,909 |
| April | 5,789 | 5,676 | 11,656 | 10,436 | 13,761 | 19,103 | 29,949 |
| May | 6,103 | 6,675 | 10,458 | 11,631 | 13,481 | 23,718 | 40,869 |
| June | 6,273 | 5,417 | 11,003 | 8,547 | 15,403 | 22,537 | 41,878 |
| July | 4,244 | 5,969 | 10,197 | 8,689 | 15,516 | 22,607 | 39,721 |
| August | 5,914 | 4,675 | 13,025 | 9,817 | 14,455 | 24,769 | 39,319 |
| September | 6,753 | 4,114 | 10,403 | 12,330 | 14,953 | 24,344 | 36,546 |
| October | 6,966 | 4,794 | 11,731 | 14,305 | 18,939 | 24,740 | 46,898 |
| November | 8,475 | 6,286 | 11,908 | 15,428 | 28,232 | 25,529 | 40,521 |
| December | 12,353 | 8,754 | 11,100 | 15,051 | 41,356 | 32,020 | 48,666 |
| Total | 79,732 | 78,079 | 121,748 | 137,025 | 214,598 | 291,944 | 436,322 |

[1]Monthly figures do not add to official statistics for each year.

## OUTLOOK FOR 1974

Assuming that the Japanese economy remains relatively stable, and assuming a reasonable continuation of Japan's shrimp imports, it is likely that 1974 imports will increase to over 150,000 tons worth more than $500 million.

As in previous years the period between January and April should see reduced imports (5,000 to 8,000 tons/month) which will gradually increase (10,000 to 11,000 tons/month) through July. Between that month and September imports should remain steady (around 10,000 tons) and then increase to 12,000 tons or more during October and November. December 1974 imports should remain very high, depending on the level of the November imports.

Naturally Japan's shrimp imports will depend heavily on the value of the Japanese yen. The outlook for the yen is not particularly bright for the near future. The yen was valued at 263:US$1 in September 1973, but has since declined in value to approximately 300:US$1. Some Japanese traders believe that the yen will ultimately return to the old valuation of 360:US$1. Japanese shrimp importers, in that event, would tend to reduce their imports to avoid losses.

However, in spite of monetary fluctuations, the Japanese public has grown to expect and demand shrimp. This is especially true during the year-end celebrations. Japanese housewives have used their influence to purchase home refrigerators, thus allowing them to store frozen shrimp at home. With more and more Japanese able to keep frozen shrimp and with more Japanese growing accustomed to enjoying shrimp it is a certainty that Japan's shrimp imports will continue to expand in the coming years.

## ACKNOWLEDGMENTS

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MFR PAPER 1077

*Opportunities exist for U.S. fishermen to expand the skipjack tuna fishery.*

# The Skipjack Tuna, *Katsuwonus pelamis*, an Underutilized Resource

WALTER M. MATSUMOTO

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## INTRODUCTION

The tunas are the most important of the large fishes constituting the exploited pelagic resources of the world oceans. The largest catches of tunas, including the yellowfin tuna, *Thunnus albacares;* the bigeye tuna, *T. obesus;* the bluefin tuna, *T. thynnus;* the southern bluefin tuna, *T. maccoyii;* and the albacore, *T. alalunga,* are taken with deep-fishing longline gear in the pelagic waters of noncoastal areas. The skipjack tuna, *Katsuwonus pelamis,* is taken at the surface, mostly with purse seine and pole-and-line gear. It is also taken incidentally with the longline. Skipjack tuna constitutes about 30 percent of the total tuna catch, and in recent years has come to replace the yellowfin tuna as the dominant species.

Recent studies of longline catches indicate that, except for the bigeye tuna in the Atlantic and possibly the albacore in the South Pacific, all the tunas taken with the longline are now being exploited at or near their maximum sustainable yields in the Atlantic, Pacific, and Indian Oceans (Rothschild and Uchida, 1968; Kikawa et al., 1968; Hayasi et al., 1970; Suda, 1971; and Skillman[1]). The skipjack tuna is the only species of tuna presently exploited in large commercial quantities that can withstand large increases in fishing pressure. Unlike most other tunas that are caught in large quantities in midocean areas, the bulk of the skipjack tuna is generally taken in waters associated with land masses. Yet its occurrence in tropical and subtropical areas far removed from land, as evidenced by incidental catches on the longline gear, demonstrates that the species is not fully exploited, despite the tremendous increase in fishing in recent years in the western equatorial Pacific.

[1] Skillman, R. A. 1973. An evaluation of the South Pacific albacore, *Thunnus alalunga,* fishery and its potential for expansion. Unpublished report, 22 p., 5 tables and 11 figures. Southwest Fisheries Center, National Marine Fisheries Service, NOAA, Honolulu, HI 96812.

## FISHERIES AND DISTRIBUTION OF FISH

The catch statistics (FAO, 1966, 1972) show that in the most recent 6 years, 1966-71, the annual world production of skipjack tuna has been maintained at the 300,000-350,000 metric ton (MT) level, up from roughly 200,000-250,000 MT in years prior to 1966 (Table 1). The total catch appears low, probably due to incomplete reporting of catches from areas that have expanded rapidly in the last few years. A most obvious discrepancy is noted in the catch from the Indian Ocean. The catches for 1970 and 1971 are given as 100 MT, but according to Sivasubramaniam (1972) catches of skipjack tuna there have increased rapidly since 1969, and at present about 45,000-50,000 MT are taken from this ocean. A recent summary of the world's catch of skipjack tuna for 1971 by Joseph (in press) shows an even greater discrepancy; his estimated total of 438,000 MT exceeds that of the FAO statistics by 108,000 MT. Joseph's breakdown of the total catch by oceans shows 82,000 MT from the Atlantic, 39,000 MT from the Indian, and 317,000 MT from the Pacific. In all three oceans his catch estimates exceed the totals of the FAO statistics.

Despite these discrepancies, the FAO records are useful for determining long-term catch trends. The catch records (Table 1) reflect the fact that skipjack tuna is fast becoming, if it is not already, the dominant species in the catches of tunas. Prior to 1966 the yellowfin tuna dominated the catch, but in the 6 years beginning in 1966, skipjack tuna has dominated the world catch in 3 and possibly 4 years. Joseph's estimates for 1971 show that the skipjack tuna catch exceeded that of yellowfin tuna by 130,000 MT.

Up to recent years, the major skipjack tuna fisheries were concentrated in only a few places in the Pacific Ocean; the U.S. fishery in the eastern Pacific off the coasts of Baja California, Central America, and northern

**Table 1.—Annual landings (in 1,000 metric tons) of skipjack tuna from the major oceans (FAO, 1966, 1972).**

| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlantic Ocean | 0.3 | 0.3 | 2.2 | 1.4 | 10.0 | 10.4 | 13.0 | 24.3 | 18.3 | 34.7 | 36.0 |
| Northwest | | | | | 0.0 | 0.0 | 0.0 | 1.8 | 0.4 | 0.7 | 1.5 |
| Western central | No breakdown by area | | | | 1.0 | 1.0 | 1.1 | 1.7 | 1.2 | 1.4 | 1.5 |
| Eastern central | | | | | 7.1 | 6.0 | 8.4 | 15.8 | 14.4 | 31.6 | 32.0 |
| Southwest | | | | | 0.5 | 0.6 | 1.5 | 0.8 | 0.4 | 0.0 | 0.0 |
| Southeast | | | | | 1.4 | 2.8 | 2.0 | 4.2 | 1.9 | 1.0 | 1.0 |
| Indian Ocean | — | — | — | — | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.1 | 0.1 |
| Western | No breakdown by area | | | | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 |
| Eastern | | | | | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 |
| Pacific Ocean | 219.0 | 252.4 | 200.8 | 226.5 | 237.4 | 310.1 | 337.4 | 275.1 | 271.1 | 288.5 | 294.0 |
| Northwest | | | | | 145.8 | 208.4 | 176.0 | 147.6 | 163.1 | 166.2 | 206.8 |
| Northeast | | | | | 0.2 | — | 0.1 | — | 0.1 | 0.2 | 0.3 |
| Western central | No breakdown by area | | | | — | 35.7 | 35.2 | 42.3 | 41.5 | 53.6 | 0.7 |
| Eastern central | | | | | 76.2 | 54.1 | 106.9 | 74.4 | 51.4 | 58.3 | 79.0 |
| Southwest | | | | | 1.6 | 1.6 | 1.7 | 1.9 | 1.6 | 1.5 | 1.5 |
| Southeast | | | | | 13.6 | 10.3 | 17.5 | 8.9 | 13.4 | 8.7 | 5.7 |
| Total | 219.3 | 252.7 | 203.0 | 227.9 | 247.5 | 320.6 | 350.6 | 299.7 | 289.7 | 323.3 | 330.1 |

South America, the northwestern Pacific fishery, which includes the fisheries off Japan, Formosa, and Ryukyu Islands, and the Japanese southern water fishery in the western equatorial Pacific. Between 1965 and 1970 the northwestern Pacific fishery contributed annually 147,000-208,000 tons to the world catch, the Japanese southern water fishery contributed 35,000-54,000 tons and the American fishery (excluding Hawaii) contributed 64,000-124,000 tons (Table 1). Since 1970 two more areas, Sri Lanka (Ceylon)-Laccadive-Maldive Islands in the Indian Ocean and the eastern equatorial Atlantic, have developed into significant fisheries, the latter contributing more than 32,000 tons. Together, these five areas contributed slightly more than 97 percent of the total world catch in 1970 and 1971.

A small-scale commercial skipjack tuna fishery dating back to the early 1900's exists in the Hawaiian Islands (June, 1951). This fishery produces about 4,600 tons per year (Rothschild and Uchida, 1968). Other small-scale fisheries in the Pacific Ocean are situated in Tahiti, where as much as 730 tons were taken in 1966 (Brun and Klawe, 1968), and in New Caledonia (Rothschild and Uchida, 1968). More recently the Japanese have begun to expand their pole-and-line fishing operations into the southwestern Pacific, particularly in the New Guinea-Solomon Islands area. With as many as 19 boats operating at any one time in the Bismarck Sea (New Guinea), the 1971 catch of skipjack tuna totaled 16,860 MT (Kearney, 1973).

Although the major skipjack tuna fisheries are concentrated in a few places, the species is widely distributed in all oceans. It has been taken as an incidental catch on the tuna longline as far north as lat.40°N in the western part of both the Atlantic and Pacific Oceans, as far south as lat.40°S in the western part of the Indian and Pacific Oceans, and as far south as lat.40°S in the Atlantic Ocean (Fig. 1). Longitudinally, it has been taken continuously across the breadth of both the Indian and Pacific Oceans.

## BIOLOGY AND ECOLOGY

Until recent years little fishing for skipjack tuna was done in the Atlantic and Indian Oceans. Consequently, research on the species and resource has been virtually limited to that in the Pacific Ocean.

It is now known that skipjack tuna begin spawning when they are about 40 cm long, and that each fish spawns between 100,000 and 2,000,000 eggs per spawning (Yoshida, 1966). The number of eggs spawned varies greatly with size of fish and even among fish of the same size. Spawning generally occurs throughout the year in tropical waters, but only in the warm seasons (late spring to early fall) in subtropical waters. Although spawning is greatly influenced by warm water and most skipjack tuna larvae are found in waters with surface temperature above 24°C, it is not uncommon to find them in waters below 23°C. Data collected by the Honolulu Laboratory, National Marine Fisheries Service, indicate the lowest temperature in which skipjack tuna larvae were found was 22.1°C. The larvae of skipjack tuna are distributed widely in all three oceans (Ehrenbaum, 1924; Klawe, 1960; Richards, 1969; Ueyanagi, 1969, 1971), but more so in the Pacific than in the others (Fig. 1). The distribution of larvae is narrowed latitudinally in the east and greatly expanded in the west, reflecting the response of spawning to warm water. In spite of their wide latitudinal range in the western and part of the central Pacific, most of the larvae are found in equatorial waters west of long.145°W between lat.20°N and 10°S. To the east of long.145°W the band of heavy concentration of larvae is even narrower, between lat.10°N and 10°S. The principal spawning area along this band is located in the central Pacific between long.150°E and 150°W (Fig. 2).

Although there have been a number of studies on age and growth of the skipjack tuna, only a few have attempted to assign ages to specific size groups (Aikawa and Kato, 1938; Brock, 1954; Schaefer, 1960; Yokota et al., 1961; Kawasaki, 1965; and Yoshida, 1971). Of these, even fewer agree as to the size of fish at age 1 and above age 4. The closest to an agreement is noted in fish of ages 2 and 3 (fish of 45-52 cm and 63-67 cm, respectively), which make up the bulk of the commercial catch. Prior to

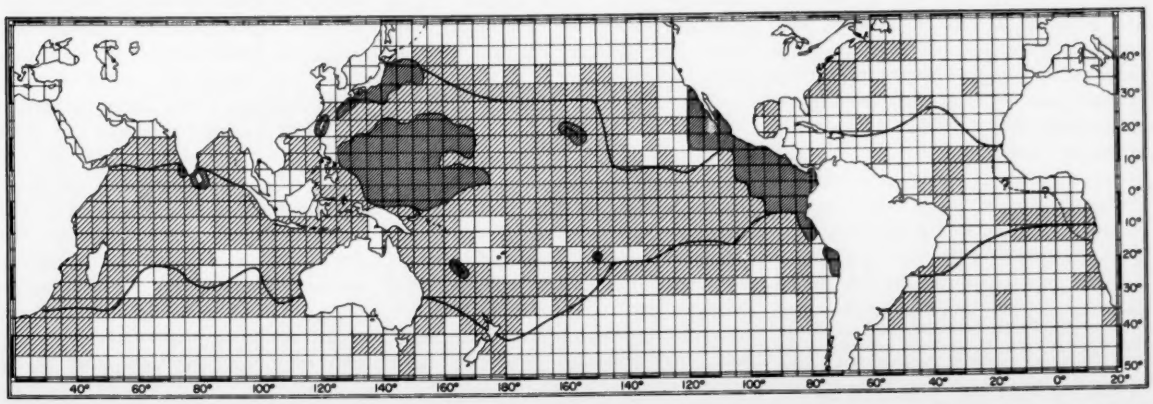


**Figure 1.—Areas of present skipjack tuna fisheries (dark shaded) and areas where skipjack tuna were taken incidentally on longline gear (light shaded) by the Japanese in the years 1969-71 (Fisheries Agency of Japan, 1971, 1972, 1973). The broken line off western Africa represents the estimated boundary of the eastern Atlantic skipjack tuna fishery. The northern and southern boundaries of larval skipjack tuna distribution are shown by solid lines.**

their entry into the various fisheries, the young, after having spent some time within the spawning grounds, gradually spread out. (Kawasaki [1965, 1972] gives a detailed summary of the movement of skipjack tuna by age groups.) By the time the skipjack tuna have attained age 2, they have reached their widest distribution: in the west into waters off northern Japan; in the east into waters off Central America; off Baja California to the north, and northern Chile to the south. In the western Pacific these fish retreat south in the winter to spawn and return to the north as age 3 fish in the following summer. Only a small portion of older fish return north in subsequent years. In the eastern Pacific the age 2 fish make up the bulk of the fishery. These fish return to the central Pacific spawning grounds and, based on size distribution figures in Broadhead and Barrett (1964), probably reappear in the fishery as age 3 fish, off Mexico and Revilla Gigedo. A somewhat different situation exists in the central North Pacific. In waters around the Hawaiian Islands fish in their fourth year (72-84 cm) are taken in most years and these fish make up 40-80 percent of the catch during the peak fishing months, June-August (Rothschild, 1965). Equally large skipjack tuna are taken also in waters of the Marquesas and Society Islands (Rothschild and Uchida, 1968).

The northward and southward expansion of the skipjack tuna distribution follows a regular seasonal cycle (Matsumoto[2]). In both northern and southern hemispheres maximum poleward movement of fish occurs in their respective summer-fall season. In addition to this north-south seasonal movement the skipjack tuna also move along with the prevailing ocean currents (Fig. 3), foraging on organisms that are being transported therein. The combination of these two movements thus produces a roughly circular path, so that the resultant movement of skipjack tuna is counterclockwise in the South Pacific and clockwise in the North Pacific, except in the eastern part where it is counterclockwise (Fig. 4), similar to the current flow around the North Pacific Equatorial Water mass. Although Matsumoto's study was based on catches made with the longline, a gear that normally takes the larger and deeper-swimming tunas, the results are applicable to surface caught skipjack tuna, since the longline gear is capable also of taking skipjack tuna as small as 45 cm, the modal size common to most of the surface fisheries.

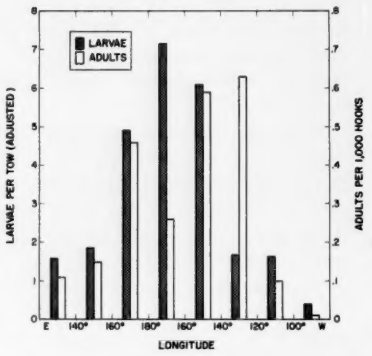


**Figure 2.—Larval and adult skipjack tuna abundance across the Pacific Ocean between lat.20°N and 10°S (from Matsumoto[2]).**

Before proceeding with resource assessment it is important that the population structure of the skipjack tuna be reviewed. Fujino (1970, 1972) has concluded, on the basis of serological studies, that in the Pacific Ocean a western subpopulation of skipjack tuna exists in both the northern and southern hemispheres west of a line running from southeastern Japan through the Bonin, Mariana, Marshall, and Gilbert Islands, between New Hebrides and Fiji Islands, and between Australia and New Zealand; and that this subpopulation is genetically distinct from the central-eastern Pacific subpopulation(s) to the east of this line. Fujino further noted that although both types of fish are found in Japanese waters, fish of the western subpopulation depart from the area within a few days of the entry of fish of the eastern-central Pacific subpopulation in September. This has been corroborated by length-frequency data showing two groups of 2-year-old skipjack tuna appearing in southeastern Japan during August (Kawasaki, 1972) with modal lengths differing by 5 to 6 cm.

It is not unlikely that the movement patterns shown in Figure 4 represent movements of stocks of skipjack tuna. The two westernmost stocks, one each in the northern and southern hemispheres, clearly belong to the western subpopulation and all other stocks to the east are of the eastern-central subpopulation. The intersecting of movement patterns from one stock to the next in the central and eastern Pacific gives rise to the thought that the progeny, if not the adults, could move from east to west in the northern hemisphere and from west to east in the southern hemisphere (Matsumoto[2]). Matsumoto has also shown that the skipjack tuna can move back and forth across the North Equatorial Countercurrent.

## RESOURCE ASSESSMENT

Several estimates have been made of the potential yield of skipjack tuna in the Pacific Ocean. With the present state of knowledge about the parameters governing the dynamics of skipjack tuna populations, the estimates obtained thus far must be considered tentative and should be used with great caution. The pitfalls in such preliminary estimates are numerous, the most dangerous being that once an estimate is made, "it tends to stand by itself" (Kawasaki, 1972), and may be quoted out of context and become accepted as fact without reference to the author's qualifying assumptions and conditions. Such has been the fate of the estimates given by Rothschild (1966) and the Japan Fisheries Agency. The latter is summarized in Kawasaki (1972). Let us examine some of these.

Rothschild (1966), using the Beverton-Holt method, estimated the yield potential of skipjack tuna in the central Pacific Ocean. His estimates represented the potential yield of the escapement stock (fish that leave the fishery) of the eastern Pacific fishery in the event that the fishery continued to harvest these fish during their return to the central Pacific. He gave two estimates, one computed for a sojourn time of 2 months (sojourn time was defined as the time a fish

[2] Matsumoto, W. M. In preparation. Distribution, relative abundance, and movement of skipjack tuna, *Katsuwonus pelamis*, in the Pacific Ocean based on Japanese tuna longline catches, 1964-67. Southwest Fisheries Center, National Marine Fisheries Service, NOAA, Honolulu, HI 96812.

spends in the fishing area), which he obtained from tag returns and which he considered rather short, and the other for a more conservative sojourn time of 6 months, selected arbitrarily. The first estimate was a fivefold to seventeenfold increase in yield and the second a twofold to sixfold increase. Using 70,000 tons as the annual average, these estimates correspond to increased annual catches of from 350,000 to 1,200,000 tons and from 140,000 to 420,000 tons.

Silliman (1966), employing a population-simulation method to the eastern Pacific fishery catch data, estimated a maximum yield of 225,000 tons, an increase of 155,000 tons or about twice the annual average catch. This estimate falls within the range of Rothschild's estimates based on a 6-month sojourn time. However, as noted by Rothschild, since the escapement stock almost certainly mixes with skipjack tuna that never circulate through the eastern Pacific fishery area, the estimates of yield must be highly conservative. This would apply also to Silliman's estimate.

The Japanese have come up with various estimates of potential yields of skipjack tuna for the Pacific as well as the Atlantic and Indian Oceans.

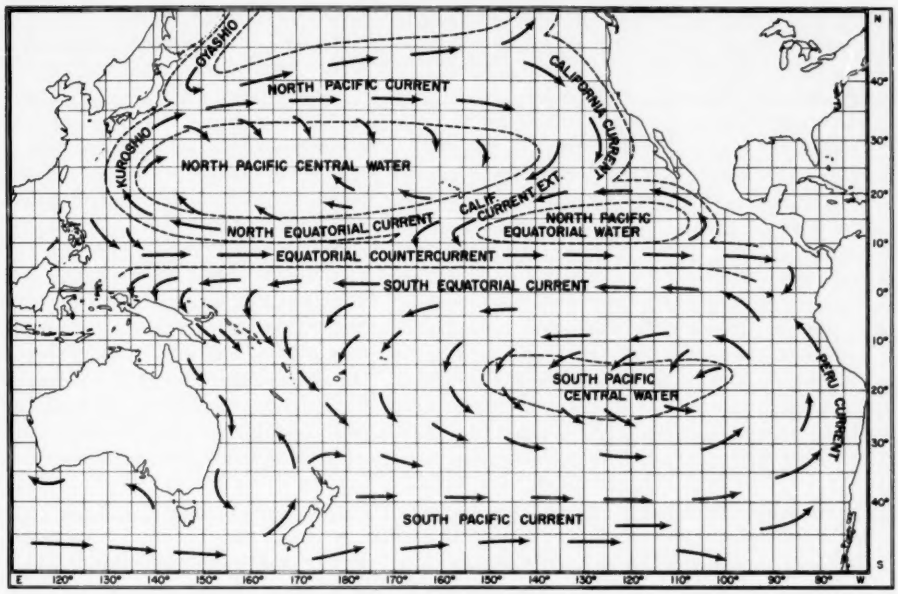


**Figure 3.—Schematic diagram of the principal currents and water masses in the Pacific Ocean (from Matsumoto[2]).**

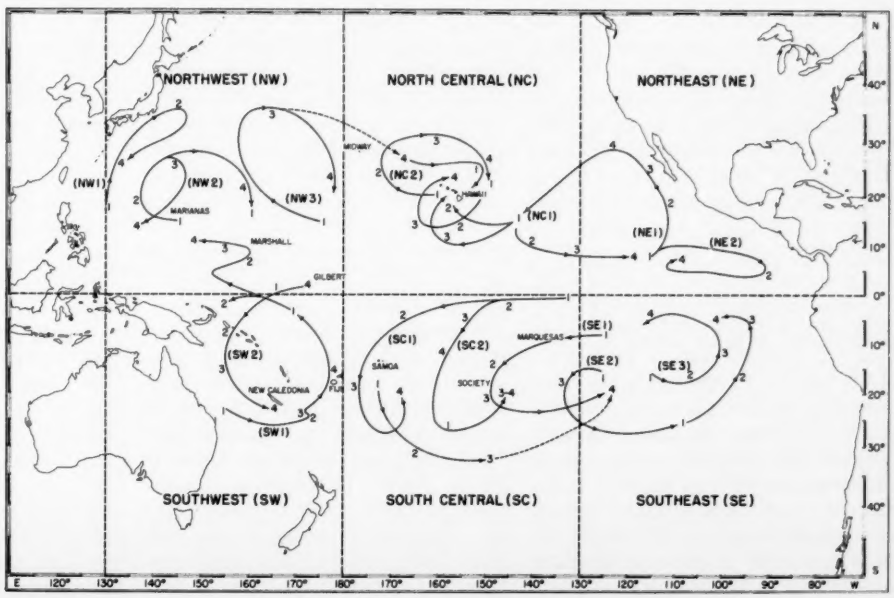


**Figure 4.—Assumed movement of the various stocks of skipjack tuna in the Pacific Ocean. The numerals along the migratory routes represent quarters and locations of high catch-per-effort cells of skipjack tuna taken by the Japanese longline fishery, 1964-67. Stock designations are shown in parentheses.**

According to Kawasaki (1972), the estimated yields published by the Japan Fisheries Agency are as follows:

| Area | 1,000 tons |
|---|---|
| 1. Japanese coastal | Increase of 200-400 |
| 2. Entire Pacific | Increase to 1,000 |
| 3. Indian Ocean | 200-300 |
| 4. North Atlantic | 100 |
| 5. South Atlantic | 100-150 |

The author of these estimates is not known; however, in 1971 Akira Suda, Far Seas Fisheries Research Laboratory, Shimizu, Japan, in commenting on his estimate of potential production of skipjack tuna in the Pacific Ocean of between 800,000 and 1,000,000 tons, explained the method used in arriving at his estimate (excerpts from talk given at the June 1971 Conference of the Japan Fisheries Resources Conservation Association. *In* Kawasaki, 1972.). He based his estimate on the premise that since from 1.7 to 1.8 times more skipjack tuna larvae were taken than larvae of other tunas, the spawning stock of skipjack tuna was also from 1.7 to 1.8 times (rounded off to 2) that of other tunas, and that therefore the potential production of skipjack tuna should be 2 times 400,000-500,000 tons, the production of other tunas. The method used to obtain 1 and 2 above could be similar to this.

The conclusion that the skipjack tuna yield should be twice that of all other tunas because there are twice as many skipjack tuna larvae seems to be an oversimplification of a complex conversion. If we look at the various factors permitting such a conversion, we find that this 2:1 ratio advantage in favor of the skipjack tuna soon disappears. First, let us say that to produce a 1:1 ratio of skipjack tuna larvae to all other tuna larvae, there should be 4 times as many skipjack tuna as all other tunas, since the fecundity of the skipjack tuna is roughly one-fourth that of other tunas (comparison made on the median number of eggs for skipjack tuna and for yellowfin and bigeye tunas). To produce a 2:1 ratio of larvae there should be 8 times more skipjack tuna as all other tunas. But since it requires roughly eight skipjack tuna to equal the average weight of all other tunas (taking 4.5 kg as the average weight of the skipjack tuna and 35.5 kg as the average weight of other tunas), the conversion factor for skipjack tuna yield to that of other tunas approaches a 1:1 ratio, far different from the 2:1 ratio used by Suda.

Other factors, either not considered or assumed to be equal for all tuna species in the above estimates are the mortality rates of eggs, larvae, and juveniles of the different species and the capability and efficiency of the various fishing gear used. Corrections for these factors could change the estimates further. Estimates 3, 4, and 5, based on yields proportional to that estimated for the Pacific (2), relative to the areas occupied by the skipjack tuna (or larvae) in the respective oceans, are equally speculative.

Despite the weaknesses in the various estimates of potential yield, sizable increases are still possible in most existing fisheries. The increases could come from harvesting more of the fish that escape capture within the fishing area by improving the gear or by following the fish further along the escape route, as noted by Rothschild (1966). This is especially applicable to the eastern Pacific fishery. In the western Pacific Ocean the situation is different. The escapement stocks from the Japanese coastal fishery, which include skipjack tuna of two subpopulations, are already being fished in the Japanese southern water fishery. The reduction in the catch rates noticed in the latter fishery (Kasahara, 1971), especially in the western sector or original fishing grounds, indicate that exploitation of skipjack tuna of the western Pacific subpopulation is nearing the maximum sustainable level. The increases in the western Pacific Ocean, therefore, must come from fish of the central-eastern Pacific subpopulation in the eastern sector of the Japanese southern water and coastal fisheries.

Sizable increases in yield should also be possible in several areas outside the present commercial fisheries. The locations of skipjack tuna stocks (Fig. 4), and the plots of catch rates of skipjack tuna taken on the tuna longline in 1969-71 (Fig. 5) should be useful in pointing out areas that could develop into new fishing grounds. In the Pacific Ocean most of such areas are in the southern hemisphere: the Marquesas-Tuamotu-Society Islands, the Phoenix-Tokelau-Samoa Islands, and the Tonga-Fiji-New Hebrides-New Caledonia Islands. A recent attempt at fishing in Tahitian waters (Society Islands) by a pole-and-line boat from Hawaii resulted in a catch of 182 tons of skipjack tuna in a 3-month period (January-March 1973). The catch compared favorably with that taken in the Hawaiian fishery during the peak months of the season (June-August). Commercial operations by the Japanese pole-and-line vessels in the waters of Papua-New Guinea, the Solomon Islands, and New Caledonia-New Hebrides Islands also have produced favorable results.

Worthy of investigation is the Leeward Islands area extending northwestward from the Hawaiian Islands to Midway. There are ample reports of tuna school sightings, based on a number of exploratory fishing cruises, to indicate possible concentrations of skipjack tuna there (Rothschild and Uchida, 1968). Farther to the northwest of the Leeward Islands, Japanese bait boats ventured to the Milwaukee Bank area (lat.31°-36°N, long.170°-174°E) in the summer (July-September) of 1972. Although the catches were small, the landings per boat-trip averaged 109 tons, much better than the average landings (71.9 tons) of boats fishing in the Japanese southern water fishery.

Skipjack tuna have not been taken as consistently in the Atlantic Ocean as in other oceans with the longline gear, and therefore other means must be used to locate possible areas of skipjack tuna abundance. On the basis of similarities in the westward flow of equatorial currents and their deflections to the north and south at the western extremities of the Atlantic and Pacific Oceans, it is reasonable to assume that skipjack tuna would be similarly distributed in both oceans. If so, areas favorable for skipjack tuna concentrations in the Atlantic Ocean should be off the southeastern coast of Brazil and from off the northeastern coast of Brazil through the West Indies. The eastern Atlantic area off the coast of Senegal to Angola is already developing into a fishery of major importance.

In the Indian Ocean the likely sources of skipjack tuna should be in the northwestern part from Madagascar to the Arabian Sea, and around the southern part of India beyond the

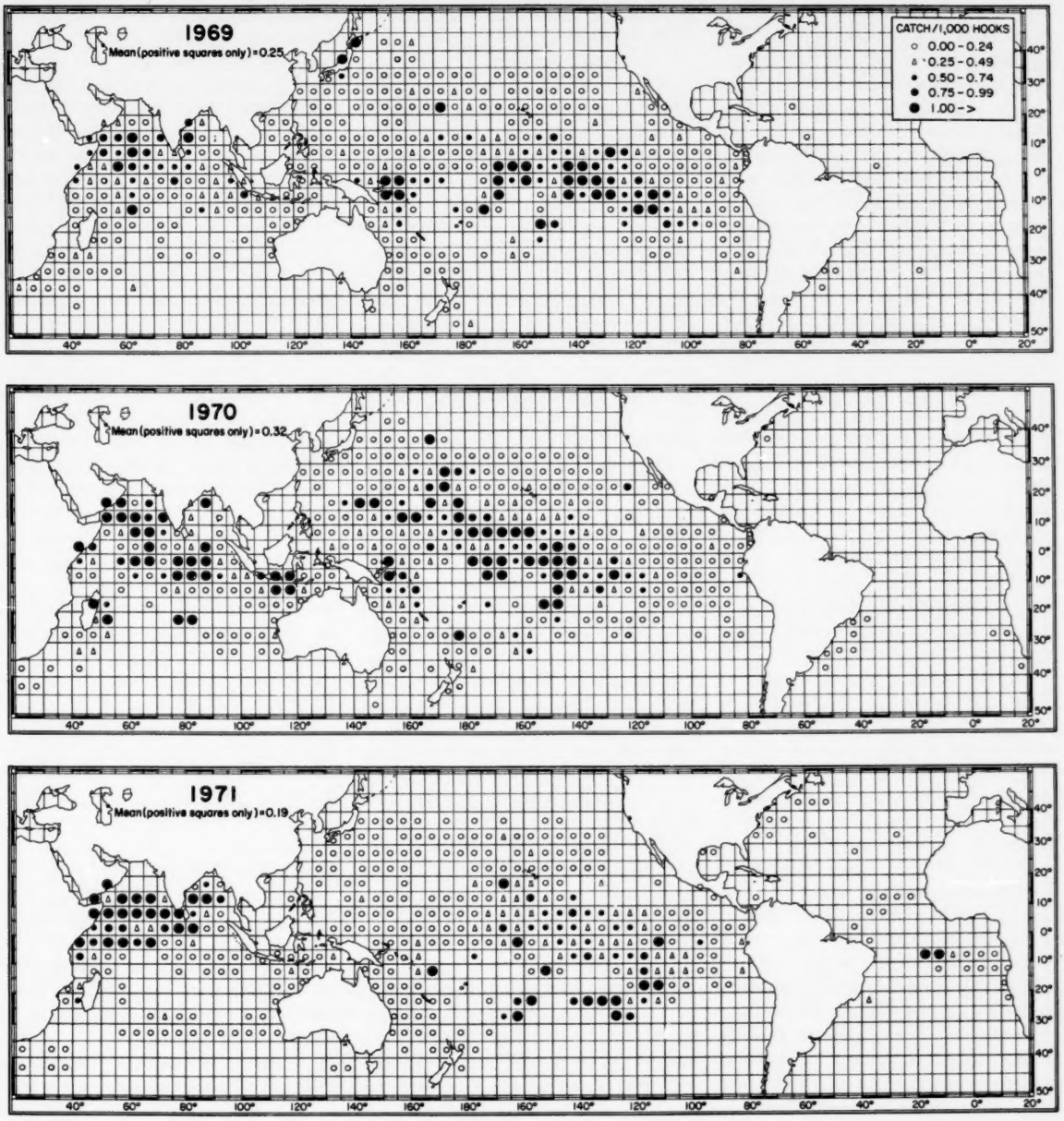


**Figure 5.—Catch rates of skipjack tuna taken in the Japanese tuna longline fishery, 1969-71 (Fisheries Agency of Japan, 1971, 1972, 1973).**

limits of the present drift-net fishery. Other possible areas are in waters off Sumatra and Java.

## HARVESTING

The bulk of the skipjack tuna catches in the major oceans are made either by pole-and-line gear using live bait as chum or by purse seine. Both types of gear are used in the eastern Pacific, the Japanese near-coastal, and the eastern Atlantic fisheries. In the Japanese southern water fishery in the Pacific, however, the pole-and-line gear accounts for virtually the entire commercial catch of skipjack tuna.

There are advantages and disadvantages to either type of fishing. In pole-and-line fishing, the biggest problem is its dependence upon live bait. Not only must the bait be available, but the suitability and hardiness of the baitfish and the capability of keeping them alive over long periods must be adequate. Because of these problems, fishing by this method was for years limited to coastal waters. In recent years the Japanese have expanded their pole-and-line fishery into waters of the United States Trust Territory of the Pacific Islands by transporting baitfish from Japan. Because of the long distances to the fishing grounds and the need for large bait holding

capacities, only large vessels (>100 tons) were involved. At the present stage of capability in bait handling and bait holding techniques, these vessels have about reached the limit of their operational distance. Further expansion into the southern hemisphere or up to and beyond the international date line in the northern hemisphere has to resort to the use of baitfish taken within the fishing area. However, most small Pacific islands lack suitable baitfish in sufficient quantities to support any sizable fleet of large fishing vessels. An additional problem involved in this type of fishing is the response of skipjack tuna to the bait. Not all of the schools sighted are fished and not all of the schools fished result in catches. In the Hawaiian skipjack tuna fishery, for example, about 50 percent of the schools fished (chummed) do not result in catches (Rothschild and Uchida, 1968). There are advantages, however, to this type of fishing: (1) it can be done from small vessels, (2) any size school may be fished, and (3) it is not hampered by oceanographic conditions such as clear water and thermocline depth, nor by fast moving schools.

In purse seine fishing, problems associated directly with baitfish are eliminated, but other problems such as deep thermocline, clear water, and size and mobility of schools, are encountered. The traditional purse seine fisheries for skipjack tuna have been successful because the fishing area was characterized either by murky waters, shallow thermocline, or the presence of a marked front between warm and cold currents. In equatorial waters, however, the waters are exceptionally clear and the thermocline is deep enough to permit fish schools to escape by diving beneath the net before it has been pursed. This is not to say that there are no suitable seining sites in the equatorial areas. There are areas with shallow thermocline, especially along the edge of the equatorial counter-current, but the skipjack tuna are not limited in their distribution to these areas alone. Recent developments in net design, such as using monofilament nylon netting to make it lighter and increasing the size of the net, have improved the efficiency of the gear, but more improvement is needed in gear modification and specialized techniques if we wish to harvest skipjack tuna in equatorial waters.

The difficulties and problems faced in fishing for skipjack tuna by both pole-and-line and purse seine methods in distant waters certainly will not be solved overnight. Yet from the evidence presented in the foregoing discussions, it is more than likely that skipjack tuna are available in sizable quantitites in many areas not now fished commercially. For the immediate future, at least until modifications to the purse seine for mid-oceanic use have been made and tested successfully, the development of techniques to transport live baitfish over great distances could be the surest way to take advantage of the resource in the central Pacific.

The Japanese southern fishery operation has shown that the anchovy, *Engraulis japonicus*, can be transported successfully for distances up to nearly 2,000 miles. Furthermore it has been reported that this baitfish can normally survive for about 5 weeks (Yabe, 1972). If the eastern Pacific northern anchovy, *E. mordax*, which are plentiful in waters off California, are as hardy as their western Pacific counterpart, they or some other suitable baitfish could be transported to Hawaii and to other South Pacific islands. And, if the transporting of such a bait can be done quickly and in large enough quantities (a study has now been initiated by the Honolulu Laboratory to ship baitfish from California to Hawaii in sufficient quantities to supply the Hawaiian skipjack tuna fishing fleet), it should be possible for large bait boats stationed in Hawaii to exploit the Leeward Islands area up to and even beyond Midway and waters to the west and south of the Hawaiian Islands, well beyond the present 30- to 50-mile range of the Hawaiian fishery.

## OPPORTUNITIES FOR THE UNITED STATES

Two points are brought to focus from the foregoing discussions. First, although all the large tuna species have already reached or are fast approaching their maximum sustainable yield levels, the skipjack tuna shows no such signs, except in the western equatorial Pacific. This is true in spite of the fact that the skipjack tuna is today the biggest yield producer among the species of tunas favored for commercial uses. Second, there are vast areas in the Pacific and other oceans that have not been fished, except by local, small-scale subsistence-type fisheries. In some areas not even this type of fishing has been done. The opportunities for development of the skipjack tuna fisheries in the Pacific hold true also in the Indian and Atlantic Oceans.

That the successful development of the skipjack tuna resource will be beneficial to the U.S. economy in many ways cannot be doubted. It will be a source of additional high-quality raw material for U.S. packers and reduce our dependence on foreign sources; it will increase employment opportunities for U.S. vessels and fishermen now restricted by catch quotas; it will in turn increase economic activity in other industries related to fishing; and finally, it will expand the economic base of the Pacific Islands, thus making their people more self-reliant and self-sufficient.

Although the resource is there, it remains fair game to all nations with the capability, desire, and willingness to develop it. In the Pacific, Japan has already begun to shift her emphasis from longlining for tunas towards fishing for skipjack tuna, and has entered into joint venture operations to fish in the Papua-New Guinea and Solomon Islands area. Fishing has been going on there since 1970. Japanese vessels also have begun to expand their operations into waters northwest of Midway. Other nations that have been longlining for tunas, such as Korea and Taiwan, have also come to realize that their future in fishing is in the skipjack tuna. In Korea a training center is now turning out skipjack tuna fishermen and both Korea and Taiwan are beginning to build up a fleet of skipjack tuna fishing vessels. If the United States is to get a fair proportion of the skipjack tuna resource, much has to be done and done quickly.

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MFR PAPER 1078

*One-pound boxes of frozen minced fish prove useful in home menus.*

# Minced Fish in a New Form

JOSEPH M. MENDELSOHN

*ABSTRACT—A new market form is introduced that is both convenient and economical for selling minced fish. Results from a market survey show that minced fish in one-pound blocks is a highly acceptable market form and could have commercial potential for both retail and institutional trades.*

### *Fish Cakes*

**2 cups minced fish (raw; thawed)**
**2 cups mashed potato**
**2 eggs (beaten)**
**4 tsp. onion (grated)**
**4 tbsp. butter (melted)**
**2 tsp. salt**
**1/4 tsp. pepper**
**1/4 tsp. garlic powder**
**2 tsp. parsley flakes.**

**Combine all ingredients and form into cakes. Deep fry or pan fry. (Approx. 6 servings).**

### *Fish in Marinara or Spaghetti Sauce*

**1 lb. minced fish (raw; thawed)**
**1/2 cup rice**
**1/4 cup onion (chopped)**
**1 can marinara or spaghetti sauce**
**1 tsp. salt**
**1/4 tsp. pepper**
**2 tbsp. oil**
**1 cup water**

**Mix fish, rice, onions and seasonings. Form into balls and pan fry until brown. Add sauce and water. Simmer (covered) for 45 min. (Approx. 6 servings).**

## INTRODUCTION

The ever-increasing need for protein has resulted in a concerted effort to develop our natural marine resource as a supply of animal protein. With the nearing depletion of traditional species of fish, research into new processes and products is in progress to fully employ the underutilized and/or overabundant species of finfish and shellfish that have a sustainable yield large enough for commercial application. Expansion of fishing efforts to underutilized species provides the added incentive of year-round fishing which affords full-time employment for the fishermen and processors and a constant and varied supply of marine protein for American consumers.

Another method for augmenting the available protein is to increase the yield of the landed fish, and this has been successfully demonstrated with the use of mechanical deboning equipment. The minced flesh produced by this means can be described as having the texture of hamburger.

With the introduction in the early 1970's of the meat-bone separator as a means for recovering the maximum amount of fish flesh from whole fish (Miyauchi and Steinberg, 1970) and from fish frames (King et al., 1971), a new fishery technology was begun. A variety of new products made from minced fish were developed (Anderson and Mendelsohn, 1971; King, 1973; King and Flick, 1973).

## PRODUCTS FROM MINCED FISH

### Large Minced Blocks

Within the last two years, there developed a shortage of blocks (16½ and 18½ pounds) made from whole fillets. The fish processors immediately turned to minced flesh as a substitute for fillets in the blocks. Today an ever-increasing amount of minced fish is being made into blocks for use in the production of sticks and portions. However, the market for these prod-

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ucts is limited, and new uses for minced fish flesh must be found if the full potential of this technology is to be realized.

### New Form—Small Minced Blocks

The market potential for a small one-pound frozen fish block, suitable for home use, was investigated. A package of this type would contain enough fish for one meal, to be purchased by the housewife for use in tested recipes provided on the package or in recipes she might develop herself. The small block could be stored in her freezer until ready for use. It could be thawed overnight for use the next day or be added directly (frozen) into certain products.

Whiting (*Merluccius bilinearis*), an overabundant species in the Gloucester, Mass. area during the summer months, was processed in a meat-bone separator and the resulting minced flesh was packaged in one-pound polyethylene-coated cardboard cartons and plate frozen.

A variety of products including fish cakes, chowders, fish in spaghetti or marinara sauce, fish and rice (kedgeree), fish stew, scalloped fish, and fish with beef were prepared and evaluated at the Atlantic Fishery Products Technology Center (AFPTC). Most of the products were highly acceptable. The recipes used to prepare the most acceptable products are shown on these pages.

### Acceptance Survey

To further test the concept, samples of the blocks were given to AFPTC personnel who normally eat fish at home. Recipe sheets shown here were provided, with the comment that the minced fish could be used in a number of favorite fish dishes. Of the nine families given the minced fish, all reported that the meals were well liked by both the children and grownups. Also noted by those making the minced-fish meal was the convenience of preparation and absence of a "fishy" smell.

### Storage Stability

After storage at -10°F for several months, the one-pound minced blocks showed signs of some dehydration along the edges near the carton open-

### *Fish and Rice — Kedgeree*

**2 cups minced fish (cooked)**
**1 cup rice (cooked)**
**2 eggs (hard boiled)**
**4 tbsp. butter**
**1 tsp. salt**
**1/4 tsp. pepper**

**Heat fish, rice, and chopped egg whites in butter. Add salt and pepper to taste. Sprinkle sieved egg yolk on top. (Approx. 6 servings).**

### *Chili Con Carne*

**2/3 lb. hamburger (raw)**
**1/3 lb. minced fish (raw; thawed)**
**1 lb. can kidney beans**
**1 8-oz. can tomato juice**
**1/2 cup water**
**1/3 cup "chili mix"[1]**

**Mix beef and fish together first. Brown 1 lb. beefish in skillet; remove from heat. Add one lb. can kidney beans undrained, one 8-oz. can tomato sauce, 1/2 cup water, 1/3 cup "chili mix". Stir until blended, bring to boil over moderate heat stirring frequently. Reduce heat, simmer 10 mins., stirring occasionally. (Approx. 4 servings).**

**[1]Available in supermarkets.**

### *Fish Chowder*

**1 lb. minced fish (raw; thawed or frozen)**
**3 potatoes (small)**
**1 onion (med. sliced thin)**
**1 cup water (& Bac*O's, if desired)**
**1 qt. milk (evaporated milk & regular milk to thicken)**
**2 tbsp. shortening - liquid or solid (or salt pork)**
**1 tsp. salt**
**1/8 tsp. pepper**
**(optional: 1 heaping tsp. Bac*O's[1])**

**Saute onions in shortening until cooked (not brown). Stir in diced potatoes, salt, and pepper. Add water and bring to boil - cover and simmer gently for 10 min. Spoon in fish, replace cover, and continue slow cooking (stir occasionally) until fish is cooked. Add scalded milk and let stand to meld. To serve, heat, add a pat of butter and dash of paprika. (Approx. 6 servings).**

**[1]No endorsement implied.**

ings. A polypropylene overwrap (2 mil thick) is now being used to prevent this dehydration; however, any overwrap having vapor barrier properties can be used.

### Production Costs

An estimate of the cost for producing the one-pound blocks was based on an ex-vessel price of 8 cents per pound for whiting. The average price of whole whiting during 1972 was 7.97 cents per pound—7.75 cents during the summer months and 6.42 cents per pound during 1973—6.24 cents during the summer months (U.S. Dept. of Commerce, 1972, 1973). Equipment, labor, utilities, packaging, etc., costs were taken from the research paper on minced whiting by Anderson and Mendelsohn (1971). Upon their cost of 31 cents a pound, an additional 9 cents per pound is included as the processor's markup on frozen products (E. S. Penn, 1973). Therefore, a one-pound block should be produced for 40 cents per pound. It was assumed that the profit margins of frozen minced fish should be similar to those of frozen ocean perch fillets. When calculated on the basis that the wholesaler sells at 15.5 percent above his cost and the retailer sells at 37.1 percent above his cost (E. S. Penn, 1973), the one-pound minced block cost at the retail level should be about 65 cents per pound.

## DISCUSSION

### Advantages of New Market Form

The one-pound frozen block of minced fish is adaptable for use in most fish recipes and as an extender to hamburger. It is convenient, requiring no preparation for use directly into many products and very economical when compared to other fish products (frozen fillets at over $1.25 per pound) and beef (hamburger at over $1.20 per pound). Only that amount necessary for a given recipe need be removed from the freezer, since if less than one pound of fish is needed for a recipe, the block can be portioned with a frozen food knife. The remaining part of the block remains frozen and can be returned to the freezer for future use.

### Future Potential

The idea of selling convenient-sized packages of frozen minced fish to the housewife can be extended to restaurants, school lunch programs, and to most institutional feeders. The highly acceptable recipes can be scaled-up to produce hundreds of servings. Five- or ten-pound blocks of frozen minced fish can be made by the processor to satisfy any requirements. As an example, if a recipe calls for 25 pounds of fish, the correct combination of ten- and five-pound blocks can be removed from the freezer and used.

Convenience-type fish blocks having a variety of flavors are possible as soon as blocks made from mixed species are accepted. Blocks made from shellfish and finfish (i.e. clams and hake, or oysters and hake) in any combination could be available to suit any taste and need.

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MFR PAPER 1079

*NMFS scientists have devised a simple method for . . .*

# Controlling Bone Particle Content in Minced Fish Muscle

MAX PATASHNIK, DAVID MIYAUCHI, and GEORGE KUDO

*ABSTRACT—Minced fish muscle recovered by flesh separators or deboners may contain some bone particles. The amount depends on the size of the final extrusion opening that the fish are pressed through, the type of equipment and its adjustment, and the species or type of fish material used. Monitoring the bone content is important since it affects the end use of the product. A simple, rapid method for quantifying the bone content is presented. It involves (1) shredding the flesh with a low-speed stirrer and (2) gravity-separation of the bone and other high density components from the floatable muscle fibers with water. The method may serve as a useful quality control tool for the producer and user of minced flesh.*

## INTRODUCTION

In recent years, the production of frozen blocks from minced fish muscle has risen sharply. Minced fish muscle obtained from either dressed fish or the trimmings and frames of the various processed species by flesh-separating machines may contain bone particles. The frequency of occurrence of particles depends largely on the size of the final extrusion opening through which the minced muscle is passed. Short pieces may appear in the minced muscle when bones are aligned transversely across the extrusion opening and are sheared off and forced through the opening by belt pressure. Longer pieces of bone may appear when, by chance, they are aligned axially with the extrusion openings and are passed through before being sheared off. Bone particles may be hard or they may be soft and pliable according to the species. The frequency of occurrence of particles may also vary with the type of the flesh-separating equipment and its adjustment, the type of material being processed, and the fish species.

Controlling the bone particle content of minced fish flesh is important in relation to its end use. Fish-stick or portion-type products are heated for a short period of time. Bones do not soften and they may be apparent in the cooked product. In sterilized, canned-type products, where bone-softening is usually assured, the bone content is not critical. Most minced flesh used today is in the first category. Bone content control therefore is of importance in relation to quality criteria and consumer acceptance. In recognition of this, the National Marine Fisheries Service "Proposed U.S. Standards for Grades of Minced Fish Blocks" cites bone particle content as an important quality attribute.

Both the producer and the industrial user of minced fish flesh need a simple method for quantifying bone content in order to determine end product quality and to verify compliance with buying specifications. Various methods of determining the bone content have been considered. Subjective sensory procedures involving visual and finger-feel location of bones were found to be unreliable. Procedures involving enzymatic digestion of the protein as a means of bone separation were time-consuming, as was chemical determination of calcium. An objective gravity-flotation procedure was found to meet the criteria of simplicity, speed, and reproducibility. The purpose of this report is to: (1) present the details of this method for assessing the bone content in minced flesh; and (2) discuss its use.

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## GRAVITY-FLOTATION METHOD FOR DETERMINING BONE CONTENT

The method involves two steps: (1) shredding the flesh with a low-speed stirring device; and (2) gravity-separation of the bone, cartilage, and other high-density components from the lower-density muscle fibers.

*Equipment.*—(1) 8-speed food stirrer-blender-disintegrator (Oster Model 847[1] or equivalent) with cutting edges of the blades blunted or rounded; (2) 5-cup blender jar; (3) shallow pan; (4) timer; and (5) absorbent paper.

*Procedure.*—(1) Weigh ¼-lb of fish sample, which may be either frozen or unfrozen; (2) place sample in 5-cup blender jar and fill with cold tap water; (3) blend at lowest speed for about 2 minutes; (4) place blender jar inside a shallow pan set in sink and run tap water into it at a flow rate of about 1 gallon/minute until water is essentially free of floating fish muscle fibers; break up any remaining aggregates of flesh at the bottom of the jar or on cutter blade or pan, and float off fibers with running water; (5) transfer quantitatively the bone, fin, and cartilage residue to absorbent paper for estimating or counting, (6) for counting, separate into components (bones, cartilage, scales, skin

[1] Reference to trade name does not imply endorsement by National Marine Fisheries Service, NOAA.

pieces, etc.); and (7) sort bones into various categories as follows:

| Soft, pliable bones | |
|---|---|
| $<1/4''$ | $\geq 1/4''$ |

| Hard, rigid bones | |
|---|---|
| $<1/4''$ | $\geq 1/4''$ |

Then count number of bones and report as number per pound. (Bone counts below 10 per ¼-pound are counted and those above are reported as $>10$. A hard, rigid bone is one that leaves a clear indentation when pressed axially between the fingers.)

The above size categories and method of reporting bones are mainly for potential use in preparing the "Proposed U.S. Standards for Grades of Minced Fish Blocks." In practice, the method for reporting bones and other non-muscle components will depend upon product specification requirements or the type of quality information needed by the buyer or seller of the products.

To determine the reproducibility of the procedure and to insure that bones are not being reduced in size during blending, the following test is suggested: (1) add 10-20 bones of known size to a bone-free sample of minced fillet flesh; (2) run through the above procedure to determine if all bones are recovered and if there is bone fragmentation; (3) repeat as required to assure reproducibility of the procedure. If fragmentation does occur, it may be due to inadequately blunted or rounded blender blades.

Larger size samples of about 1 pound can be evaluated by using a 1-gallon blender. The cutter blades may be non-destructively rounded by slipping a piece of rubber or plastic tubing over each blade. The general procedure is similar to that for the smaller size samples.

## CONTROL OF BONE PARTICLE CONTENT AND USE OF GRAVITY-FLOTATION METHOD

The gravity-flotation method is recommended as a useful quality control tool to provide reasonably accurate estimates of bone particle content for the producer, industrial user, and inspector of frozen and unfrozen minced muscle. For example, it may be used to monitor the bone content of minced flesh from bone-separating equipment for the purpose of optimizing machine adjustments so as to obtain maximum flesh yields while meeting bone content and other quality limitations for end use of the product. Minced flesh is usually obtained from bone-separating equipment operating with extrusion openings of from 1 to 7 mm. The size of the opening and the machine adjustment control the quantity and type of bone passing through with the minced flesh. This in turn determines how the flesh can be used. Thus, the use of minced flesh in fish-stick or portion-type products will undoubtedly set a limit on the number of hard bones permitted in a pound of product. Meeting such a limit may be accomplished by machine adjustment, straining of the flesh, or by dilution of coarse minced flesh with strained flesh. The use of the minced flesh of some species in spreads, snacks, or sausage-type products may require their final straining through 1- to 2-mm strainers to obtain maximum reduction in detectable bones (Patashnik et al., 1974). In heat-sterilized, canned products such as those prepared from salmon trimmings, the flesh-separating equipment can be adjusted to give maximum yields despite the resultant high bone contents since the thermal process is adequate to soften the bones.

The method can also be used to concentrate scales, fins, vertebral bones, and other debris to permit their quantitative assessment as an indication of product quality and workmanship. For example, high scale content of some commercial products indicates poor washing practices.

Inasmuch as particle size affects the product's chewability or texture, it is often useful to know whether the minced flesh is essentially fine or course or a mixture thereof. During the *first few seconds* of blending (step 3 under Procedure), the relative proportion of coarse and finely minced flesh in the product may be visually estimated. Also, if there are any off-color defects in the product, they can be readily observed during the blending.

In summary, the method is flexible in that it offers the choice of obtaining accurate bone particle counts or of making rapid visual estimates according to the needs of the user. Where only an estimate of the type and quantity of bones, scales, fins, skin, and other non-muscle debris is needed for quality control screening, the procedure may be speeded up and the various extraneous materials may be visually estimated rather than counted. A test may take from a few minutes per sample up to several minutes, depending on the accuracy desired.

In the preliminary examination of frozen minced blocks, one can rapidly determine if a bone problem exists by cutting off sample slices by knife or saw. These may be placed under running tap water and lightly surface-thawed. By running the finger across the surface, one can detect the presence or absence of significant amounts of bone protruding through the soft, thawed surface. This preliminary examination can often determine the magnitude of the bone incidence and the need for further testing by the above described method. For field examination where a blender is not available, this simplified approach may provide a crude estimate of the presence or absence of significant quantities of bone in the product.

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MFR PAPER 1080

# Seabed Drifters Used to Study Bottom Currents off Kodiak Island

W. JAMES INGRAHAM, JR., and JAMES R. HASTINGS

Although surface currents are usually emphasized in fishery-oceanography studies, bottom currents—particularly over the continental shelf—are also of great interest. A convenient plastic device for measuring bottom currents is the Woodhead-type seabed drifter, which consists of a perforated disc, 18 cm in diameter, attached to a 55-cm long stem (Fig. 1). A 5-gram weight is attached to the lower end of the stem, giving the assemblage a slightly positive buoyancy and causing the drifter to orient itself in an upright position within a few meters of the bottom. Within the last 10 years this device has been used by a number of other people (Lee et al., 1965; Lauzier, 1967; Morse et al., 1968; and Gross et al., 1969), and the rate of recovery was as high as 25 percent.

In May 1972, a modest study of residual bottom drift in the Kodiak-Afognak Island group of Alaska was carried out by the Northwest Fisheries Center of the National Marine Fisheries Service, Seattle, Washington, as part of a Marine Resources Monitoring Assessment and Prediction (MARMAP) cruise. Woodhead-type seabed drifters were released from the RV *George B. Kelez* between Albatross and Portlock Banks in hopes that recoveries would provide some knowledge of the speed and direction of bottom currents in this area, where no data were available. Some data on geostrophic currents are available offshore seaward of the shelf break where the Alaskan Stream flows southwestward at an average speed of 50 to 100 cm/sec (determined by computations from serial temperature and salinity data versus depth). These computations are not reliable in the area of the shallow continental shelf and neither sufficient vessel time nor funds were available to measure currents directly. Groups of five drifters each were bound together by inserting the stems through holes in small salt blocks which served as weights to carry the drifters to the seabed. After a short time on the bottom (approximately one-half hour), it was assumed that the block would dissolve and that the individual drifters would respond to prevailing bottom currents. A total of 475 drifters was released—25 at each of 19 locations, but 100 were released on Portlock Bank (Fig. 2).

After 1 year, 15 recoveries were reported: 6 in fish trawls, 4 in crab pots, and 5 on shore—a rate of return of less than 3 percent. Of the 25 released about 6 kilometers (4 miles) southeast of Cape Chiniak (lat. 57°33′N, long. 156°06′W) 2 were recovered on Cape Chiniak and 4 were recovered southwestward near Ugak Bay. Seven other drifters released between the shore and mid-shelf were recovered south and west of their release points.

Only two other exceptions to the general southwestward trend were reported in the northeastern part of the area. South of Afognak Island near shore one northeasterly recovery was reported, and one northwesterly recovery was reported from the larger group released on Portlock Bank. Thus, the general direction of bottom flow appears to be southwestward, similar in direction to the offshore boundary current but with a strong inshore component. Speeds ranged from 0.2 to 1.3

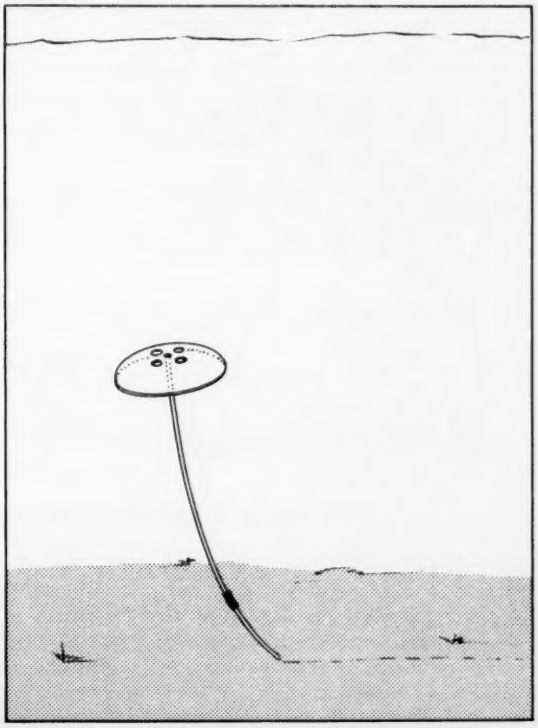

Figure 1.—Woodhead-type seabed drifter.

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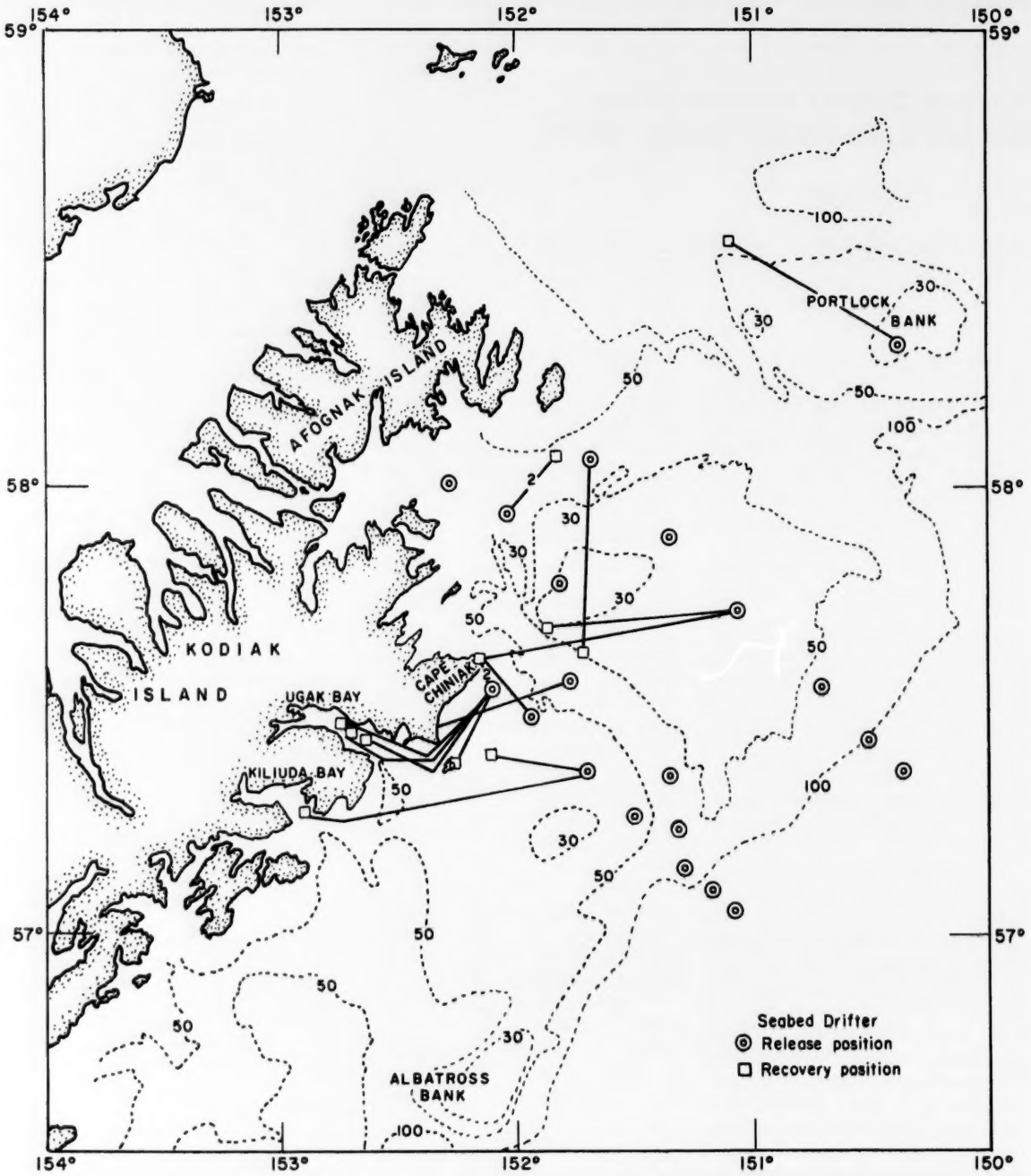


Figure 2.—Locations of seabed drifter releases and recoveries, RV *George B. Kelez*, May 1972 (depth contours in fathoms).

kilometers (0.1 to 0.7 nautical miles) per day and averaged 0.4 kilometer (0.2 nautical mile) per day. Most of Kodiak Island's coastline is rugged and thinly populated. Hence limited returns were expected from drifters stranded on shore. It was hoped, however, that recoveries would be made from foreign fishing vessels trawling in this general area, but none have been reported.

Any future studies of bottom drift in this region should be on a larger scale, with drifters released over several seasons. Lauzier (1967) used two different methods of seabed-drifter release for his study of bottom drift along the Canadian Atlantic coast: (1) releases of large numbers over a large area within a relatively short time span (cruise-type releases); and (2) releases at a

given location at regular intervals over a long time period (land or nearshore releases). These methods proved to be highly effective.

Some similarities were observed between results of our study and those in other areas. Lee et al. (1965) found that returns from the Atlantic Coast study of bottom drift indicated a rate of drift of 0.2-1.67 kilometers (0.1-0.9 nautical miles) per day for the period April 1961 to August 1964 from Nova Scotia to Florida. Gross et al. (1969) found that speeds of 0.7-2.4 kilometers (0.4-1.3 nautical miles) per day occurred in the inner continental shelf areas near the mouth of the Columbia River and that very few drifters (usually less than 5 percent) were recovered from those release locations where the bottom depth exceeded 90 meters. Although 3 of our 15 returns were reported from depths exceeding 90 meters, these were released in channels on the inshore portion of the shelf. The presence of the intense Alaskan Stream probably contributes to the absence of local returns from releases on the outer shelf near the shelf break.

A comprehensive saturation-type study with large numbers of seabed drifters released over a long time span in the Kodiak-Afognak Island group would provide significant new knowledge about the environment that would be useful to fisheries research in this highly productive area. Alverson and Chatwin (1957) have suggested that near-bottom currents have a significant effect on the transport of demersal eggs and bottomfish migration. Hebard (1959) measured currents near the surface and bottom in the southeastern Bering Sea and discussed their effect on the movement of crabs during planktonic larval stages. Several king crab studies have been undertaken in the Kodiak-Afognak Island group. It was found that king crabs follow yearly migration patterns, returning to the Kodiak-Afognak Island area during the winter to breed in these relatively shallow waters (Powell and Reynolds, 1965; McMullen, 1967).

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MFR PAPER 1081

# Distribution of Seaward-Migrating Chinook Salmon and Steelhead Trout in the Snake River above Lower Monumental Dam

JIM ROSS SMITH

*ABSTRACT—Distribution of seaward-migrating juvenile salmonids was determined from gillnet catches in impounded waters upstream from Lower Monumental Dam on the Snake River in eastern Washington. Fifty-eight percent of the chinook salmon,* Oncorhynchus tshawytscha, *and thirty-six percent of the steelhead trout,* Salmo gairdneri, *were taken in the upper 12 feet of the water mass. Significance of the vertical distribution of these species is discussed in relation to supersaturation of dissolved atmospheric gases and survival of the migrants.*

*Additional data are presented on horizontal and diel (day-night) distribution of the migrants, their direction of travel (downstream or upstream) when caught and proportions caught by mesh size of the gillnets. Effects of river discharge, temperature, and turbidity on fish distribution are considered in the analysis.*

## INTRODUCTION

Knowledge of the distribution of migrating juvenile salmonids in rivers and impoundments can be important to our understanding of their survival during passage to the sea. High concentration of dissolved gas is recognized as a potentially serious problem to valuable stocks of salmon, *Oncorhynchus* spp., and steelhead trout, *Salmo gairdneri*, in the Columbia and Snake Rivers, where direct and indirect mortalities have been attributed to supersaturated concentrations during seaward migration of juvenile fish. Concentrations as high as 140 percent saturation have occurred and are highly lethal to salmonids migrating in surface waters.

These concentrations, however, tend to become progressively less damaging as a fish dives to deeper waters. Each foot of hydrostatic pressure enables a fish to compensate for about 3 percent excess saturation (over 100 percent). Hence, the depth at which a fish travels becomes an important factor in determining overall effects of supersaturated waters on its survival. The primary objective of this study, therefore, was to obtain information on the depth traveled by juvenile salmon and trout during their seaward migration in the Snake River.

This study was part of a cooperative research effort funded by the U.S. Army Corps of Engineers, Bonneville Power Administration, and Bureau of Reclamation. It enabled us to gain further understanding of the effects of supersaturated gases on migrating juvenile salmonids.

## GENERAL EXPERIMENTAL PROCEDURE AND DESIGN

Fishing of varied mesh gillnets at selected depths and locations in the reservoir was the basic method selected for this study. This procedure was similar to that used by Smith, Pugh, and Monan (1968), which was patterned after that used by Rees (1957).

The sampling site was toward the north shore of the Snake River between one-half to three-fourths of a mile upstream from Lower Monumental Dam. The reservoir at this location is about 2,200 ft wide and has a maximum depth of about 115 ft. Two sampling stations were established; one station (nearest shore) was sampled to a depth of 48 ft, the other to 96 ft.

Both stations were in the same cross-section of the reservoir to enable a comparison of fish movement and occurrence in shallow and deep areas. Sample fishing at these stations was done on a 4-day test cycle from 23 April to 25 May 1973. At the deeper station, two nets were fished each day at different depths; vertical distance between the nets was 12 ft at all times. A single net was fished at the shallow station at one of four 12-ft levels each day. Weather permitting, nets were lifted and reset at dawn and dusk to obtain a comparison between night and day catches; otherwise the nets were checked once daily. A random selection for fishing positions was as follows:

**Shallow Station**
**Day 1 — Position 4 (36'-48')**
**Day 2 — Position 1 (0-12')**
**Day 3 — Position 2 (12'-24')**
**Day 4 — Position 3 (24'-36')**

**Deep Station**
**Day 1 — Positions 5 (48'-60') and 7 (72'-84')**
**Day 2 — Positions 1 ( 0 -12') and 3 (24'-36')**
**Day 3 — Positions 2 (12'-24') and 4 (36'-48')**
**Day 4 — Positions 6 (60'-72') and 8 (84'-96')**

Records of fish caught in gillnets included details on: (1) direction of travel (upstream or downstream) when caught; (2) species; (3) length; and (4) vertical location in net (upper, middle, or lower third). In addition, the location of fish caught in the surface nets (upper 12 ft) was recorded by 1-ft intervals of depth.

Turbidity was measured with a Secchi disc; a Whitney[1] thermometer was used for water temperature measurements. A solar illuminance meter, model LMA-8A manufactured by Montedoro Whitney, was used to measure light penetration.

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[1] Mention of trade names in this publication does not necessarily imply endorsement by the National Marine Fisheries Service, NOAA.

## SAMPLING NETS AND SUSPENSION SYSTEM

Sampling nets were constructed with monofilament nylon. Each net consisted of three panels, each 20 ft long by 12 ft deep. Respective mesh sizes (stretched measure) were ⅞ inch, 1⅛ inch, and 1⅜ inch; strand diameters were 0.015 cm, 0.015 cm, and 0.02 cm. These panels were arranged horizontally by order of mesh size to form a net 60 ft long by 12 ft deep. Each net was equipped with a leadline and floats; they were suspended by pulleys from two rafts anchored 60 ft apart at each station (Fig. 1). The pulleys were attached to concrete anchors positioned directly below each raft. Multistrand polypropylene rope ran from the surface down through the pulley blocks and back to the surface, forming an endless loop. One-half of the loop was marked at 12-ft intervals to enable accurate positioning of the nets at the desired depth.

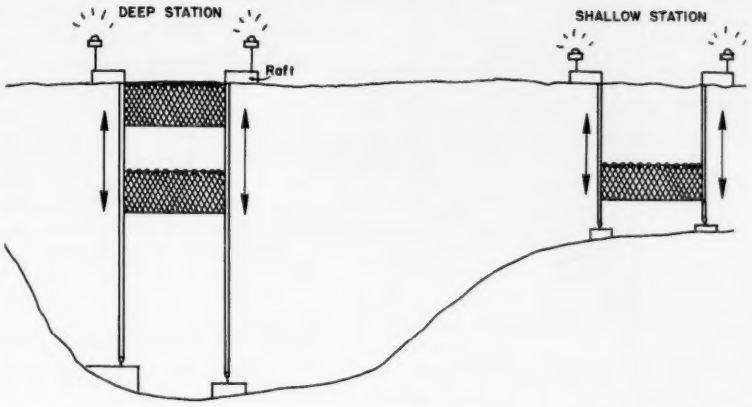


**Figure 1.—Diagramatic sketch of net suspension system for sampling of vertical distribution of juvenile salmonids in Lower Monumental pool, 1973.**

## RESULTS

Fish captured in the gillnets were principally wild and hatchery stocks of juvenile chinook salmon, *O. tshawytscha*, and steelhead trout of the Snake River system. Northern squawfish, *Ptychocheilus oregonensis*, channel catfish, *Ictalurus punctatus*, and redside shiner, *Richardsonius balteatus*, also appeared in the catches. Fifty-three percent of the steelhead trout caught were of hatchery origin. These were easily identified by their eroded dorsal fins. It was impossible to accurately distinguish between hatchery and wild stocks of chinook salmon.

Combined catches (Table 1) at the deep and shallow stations show that 58 percent of the chinook salmon and 36 percent of the steelhead trout were traveling in the upper 12 ft of the reservoir. A breakdown of catches in the upper 12 ft of the reservoir at 1-foot intervals (Fig. 2) provides further insight of fish distribution in what is probably the most critical area of the water mass. Depth distribution of fish in this area is important in computing possible losses that could occur from exposure to supersaturated atmospheric gases because hydrostatic pressure compensates for about 3 percent excess gas saturation for each foot of depth. For example, 130 percent saturation at the surface would result in about 112 percent saturation for a fish traveling 6 ft beneath the surface and approximately 100 percent for fish at 10- to 12-ft depths.

Of fish caught in the upper 12 ft of the reservoir, 80 percent of the chinook salmon and steelhead trout were in the upper 6 ft of the nets. Thus, when applied to the total catch, we find that about 46 percent (0.80 × 58) of the chinook salmon and 29 percent (0.80 × 36) of the steelhead trout were migrating between the surface and 6 ft of depth. The significance of this observation is that more chinook salmon (because of their tendency to migrate nearer the surface) than steelhead trout would be subject to losses from supersaturation of dissolved gases.

Comparisons also were made of the horizontal distribution by species, catches by mesh size, direction of migration, and the proportion of catches made during day and night. Diel occurrence of the chinook salmon and steelhead trout catches appears in Table 2. Approximately 92 percent of the chinook and 76 percent of the steelhead were taken at night (between dusk and dawn). Owing to the method of capture, the predominance of nighttime catches may not necessarily be indicative of actual migratory behavior. Gillnets characteristically are more effective during periods of reduced visibility. Hence, one might expect greater catches at night or when the water is highly turbid. Examination of catches from 24 ft and below (depths at which very little or no light prevailed) suggests, however, that most of the migration did, indeed, occur at night.

**Table 1.—Vertical distribution of juvenile chinook salmon and steelhead trout caught at shallow and deep stations in the forebay of Lower Monumental Dam, 1973.**

Shallow station

| Depth (feet) | Chinook Number of fish | Chinook % | Steelhead Number of fish | Steelhead % |
|---|---|---|---|---|
| 0-12 | 50 | 69 | 260 | 51 |
| 12-24 | 20 | 28 | 135 | 26 |
| 24-36 | 1 | 1.5 | 70 | 14 |
| 36-48 | 1 | 1.5 | 46 | 9 |
| Totals | 72 | 100 | 511 | 100 |

Deep station

| Depth (feet) | Chinook Number of fish | Chinook % | Steelhead Number of fish | Steelhead % |
|---|---|---|---|---|
| 0-12 | 93 | 53 | 181 | 25 |
| 12-24 | 43 | 24 | 156 | 22 |
| 24-36 | 18 | 11 | 119 | 16 |
| 36-48 | 3 | 2 | 60 | 9 |
| 48-60 | 3 | 2 | 61 | 9 |
| 60-72 | 6 | 4 | 62 | 9 |
| 72-84 | 2 | 1 | 32 | 4 |
| 84-96 | 5 | 3 | 48 | 6 |
| Totals | 173 | 100 | 719 | 100 |

Shallow and deep stations combined

| Depth (feet) | Chinook Number of fish | Chinook % | Steelhead Number of fish | Steelhead % |
|---|---|---|---|---|
| 0-12 | 143 | 58 | 441 | 36 |
| 12-24 | 63 | 26 | 291 | 24 |
| 24-36 | 19 | 8 | 189 | 15 |
| 36-48 | 4 | 2 | 106 | 8 |
| 48-60 | 3 | 1 | 61 | 5 |
| 60-72 | 6 | 2 | 62 | 6 |
| 72-84 | 2 | 1 | 32 | 2 |
| 84-96 | 5 | 2 | 48 | 4 |
| Totals | 245 | 100 | 1,230 | 100 |

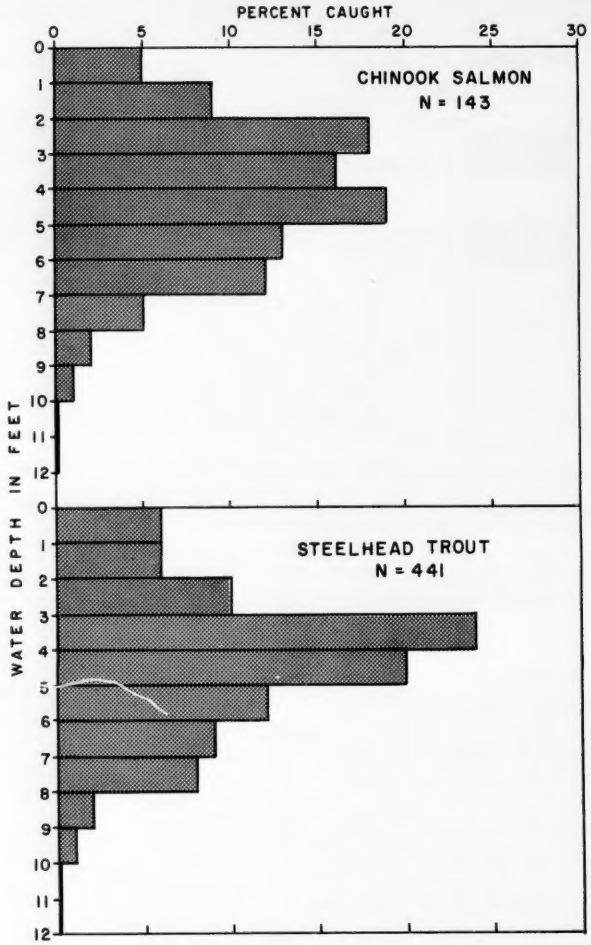


**Figure 2.—Vertical distribution (in percent) of chinook salmon and steelhead trout caught in the upper 12 feet of Lower Monumental Forebay in 1973.**

Among fish caught at these deeper levels, 76 percent (19 of 25) of the chinook and 88 percent (420 of 476) of the steelhead trout were taken at night.

Vertical distributions of the fish also were examined to determine whether demonstrable changes occurred between day and night periods. Data from catches in the upper 12 ft and from 12 to 24 ft (Table 2) were compared in this analysis. The proportion of chinook salmon catches in the surface nets (0-12 ft) increased at night whereas that of steelhead trout declined. No chinook were taken from 0 to 12 ft during the day, but at night 60 percent of the total catch in the upper 24 ft was taken in the surface nets. Steelhead catches in the surface nets declined from 74 percent during the day to 36 percent at night. If these catches reflect actual behavioral changes in the species, then chinook tend to be more surface-oriented at night whereas steelhead trout are the reverse—nearer the surface during the day.

Comparison of total catches in the upper 48 ft at the shallow and deep stations (Table 1) indicates that steelhead trout were uniformly distributed across the reservoir but that chinook clearly favored the more central portion of the reservoir. Twice as many chinook were taken at the deep or offshore station as at the shallow station (near shore). These horizontal distributions remained relatively the same from day to night (see Table 2, upper 48 ft only).

**Table 2.—Day and night distribution of juvenile chinook salmon and steelhead trout caught at shallow and deep stations upstream from Lower Monumental Dam, spring 1973.**

| Shallow station | | | | |
|---|---|---|---|---|
| Depth (feet) | Daylight | | Dark | |
| | Chinook | Steelhead | Chinook | Steelhead |
| | Number of fish | | | |
| 0-12 | 0 | 99 | 27 | 94 |
| 12-24 | 3 | 20 | 17 | 115 |
| 24-36 | 0 | 8 | 2 | 61 |
| 36-48 | 0 | 5 | 1 | 41 |
| Totals | 3 | 132 | 47 | 311 |

| Deep station | | | | |
|---|---|---|---|---|
| Depth (feet) | Daylight | | Dark | |
| | Chinook | Steelhead | Chinook | Steelhead |
| | Number of fish | | | |
| 0-12 | 0 | 48 | 38 | 49 |
| 12-24 | 2 | 29 | 27 | 136 |
| 24-36 | 1 | 6 | 1 | 88 |
| 36-48 | 2 | 10 | 1 | 51 |
| 48-60 | 0 | 9 | 3 | 51 |
| 60-72 | 1 | 3 | 5 | 60 |
| 72-84 | 0 | 4 | 2 | 27 |
| 84-96 | 2 | 11 | 4 | 41 |
| Totals | 8 | 120 | 81 | 505 |

Salmonid catches by mesh size of the gillnets were as follows: 1⅜-inch—48 percent, 1⅛-inch—45 percent, and ⅞-inch—7 percent. Eighty-six percent of the salmonids were headed downstream when captured.

## RELATIONS BETWEEN PHYSICAL CONDITIONS OF THE RIVER AND DISTRIBUTION OF JUVENILE SALMONIDS

Effects of changes in the river temperature, flow, and turbidity and the solar illumination on the horizontal and vertical distribution of juvenile salmon and steelhead trout were examined, but no specific correlations were found. I believe this may possibly be due to the lack of substantial variations in the prevailing river conditions. Secchi disc readings ranged from 34 to 54 inches. Secchi disc readings in the Snake River during the spring freshet normally range as low as 6 inches but, owing to the prolonged low runoff in 1973, the river was consistently much clearer than the norm. Readings from the solar illuminance meter indicated that total darkness in the river ranged from 16 to 25 ft. Water temperatures at the surface of the reservoir ranged from 51 to 60.5°F and generally varied between 2 and 5 degrees cooler at 96 ft (maximum depth). Total river discharge at the dam ranged from 60

to 90,000 cfs which is far below the normal range of flow in the spring. The relatively narrow range of flow volume resulted in only minor changes in current velocity, and no correlation between velocity change and catches was noted.

The unusual clarity of the river in 1973 could have had some influence on the fish distributions in this study. For that reason, additional depth distribution studies would be in order in future years to determine whether significant changes in orientation and behavior of the fish occur with increasing turbidity.

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*MFR Paper 1081. From* Marine Fisheries Review, *Vol. 36, No. 8, August 1974. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*

*NOAA/NMFS Developments*

# U.S. Seafood Consumption, Commercial Fish Landing Values Set Record Marks in 1973

Americans are eating more fish than at any time since the Federal Government began keeping records in 1909, according to data released by the National Oceanic and Atmospheric Administration.

The Commerce Department agency reported that the 1973 statistics indicate that the average per capita consumption of seafood was 12.6 pounds —an increase of slightly more than 2 percent, or 0.3 pound per person, over the 1972 figure. The 12.6 figure includes edible fish (fresh, frozen, canned, or cured) that entered usual commercial channels from all sources, and represents about 2.6 billion pounds of fish, edible weight. The increase can be attributed largely to a rise in consumption of fresh and frozen products, and to a lesser extent, canned fishery products.

The data collected by NOAA's National Marine Fisheries Service indicate that total U.S. commercial fisheries landings (products used for both edible and industrial purposes) were worth a record $907.4 million to the fishermen. The total volume, approximately 4.7 billion pounds, was almost the same as in 1972, but the value was up about 29 percent from a year ago because of higher prices paid at dockside. The 1973 average value per pound of 19.2 cents for all species also was a record high.

Total imports of fishery products reached a record high value of $1.57 billion, up from $1.49 billion a year earlier. Imports of edible fishery products were 4.7 billion pounds, up from 4.4 billion pounds in 1972. Industrial fishery products imported by the United States declined sharply from 4.6 billion pounds to about 800 million pounds. The drop reflects the world shortage of fishmeal, especially the decline in production by Peru which suffered a severe failure in its anchovetta fishery.

There were record U.S. harvests of anchovies, Pacific shrimp, surf clam meats, and snow crabs. Increased landings of bonito, Atlantic cod, croaker, Pacific sea herring, striped bass, pollock, rockfishes, scup, and whiting also contributed to the greater volume. Sharp declines occurred, however, in landings of yellowtail and Pacific flounders, Atlantic sea herring, jack mackerel, albacore tuna, bluefin and skipjack tuna, pink salmon, hard blue crabs, Dungeness crabs, Gulf shrimp, and squid. There were also slight declines in landings of haddock, Pacific halibut, menhaden, red salmon, and oysters.

The domestic shrimp fishery was the most valuable in the country. Landings of 372.2 million pounds worth $219.4 million represented a decline of 3 percent in volume but an increase of 14 percent in value compared with 1972. Shrimp accounted for 24 percent of the total dockside value of U.S. landings.

Tuna landings of 342.1 million pounds at U.S. ports were down 35.5 million pounds, 9 percent lower than in 1972. An additional 173.5 million pounds of tuna were landed by U.S. fishing craft at ports outside the 50 States, principally in Puerto Rico.

Details of these and other preliminary data dealing with U.S. fisheries are included in Fisheries of the United States, 1973. Single copies may be ordered from the Superintenent of Documents, U.S. Government Printing Office, Washington, DC 20402, for $1.50.

# *New High Seen in Gray Whale Trend Count*

The 3,492 gray whales counted off the California coast from December 18, 1973, through February 4, 1974, during the annual southward migration represents the highest total since the count began seven years ago. The annual census is taken by the Commerce Department's National Oceanic and Atmospheric Administration at Yankee Point, near Monterey, California.

The whale count, done by NOAA's National Marine Fisheries Service, begins each year around mid-December as soon as whales are seen regularly during their southerly migration and the count continues until statistics indicate that most have passed the observation point, and only an occasional straggler is sighted. Some gray whales begin leaving Arctic waters as early as October, moving toward the calving lagoons in Baja California.

The total number of gray whales counted this season (December 14, 1973, to February 9, 1974) was 3,919, but the year to year population trends are best illustrated by comparing the counts for the period of time included in each year's tabulation—December 18 through February 4, excluding Christmas and New Year's Day. For the comparable dates, the 3,492 whales counted were about 15 percent above the previous six year average.

| Year | Count |
|---|---|
| 1967-1968 | 3,120 |
| 1968-1969 | 3,081 |
| 1969-1970 | 3,064 |
| 1970-1971 | 3,034 |
| 1971-1972 | 2,588 |
| 1972-1973 | 3,304 |
| 1973-1974 | 3,492 |

The count this year was made under the direction of Allen Wolman of the NMFS Northwest Fisheries Center, Seattle, Washington. The "whale watch" is made from shore between 7:00 a.m. to 5:00 p.m. by two observers using powerful binoculars to count the whales which are sometimes seen in the surf but may be several miles offshore. NMFS scientists believe that the whales are more concentrated during the southward migration than at any other time and pointed out that other species of whales seldom mix with the gray whales during the migration.

The gray whales return to their northern habitat in large numbers in May and June as the ice breaks up, but while migrating northward off the California site, the whales are much farther offshore than during the southward journey.

The annual census taken by the NMFS is the most reliable indicator of the population trend of gray whales, but Mr. Wolman added that the count is in no way an accurate indication of the total gray whale population, only an index of relative abundance. He also pointed out that there are a number of factors such as weather conditions, visibility, and ocean currents that must be considered each year. Thus the higher count this season does not necessarily indicate an increase in the gray whale population.

The gray whale is on the U.S. endangered species list along with the finback, sei, sperm, bowhead, blue, humpback, and right whales, and is also protected under the International Whaling Convention.

## Japanese Fishing Vessel Gets Heaviest Penalties

The heaviest penalties ever levied against a foreign fishing vessel encroaching in U.S. waters, a total of $300,000, were assessed earlier this year against a Japanese vessel and its master after they were taken into custody for illegal fishing operations in territorial waters off Alaska, March 19. The Commerce Department's National Oceanic and Atmospheric Administration said that at a March 28 hearing in Federal District Court in Anchorage, a levy of $290,000 was assessed against the vessel, and a $10,000 fine imposed on its master.

Personnel of the U.S. Coast Guard Cutter *Midget*, accompanied by a fisheries enforcement agent from NOAA's National Marine Fisheries Service, boarded the 160-foot *Ebisu Maru No. 88* for using longline fishing gear 2.2 miles from the U.S. coast near Umnak Island, Alaska. The boarding party found about 50 tons of fish, mostly black cod (also known as sablefish), aboard the vessel.

The *Midget* escorted the Japanese vessel to Kodiak, Alaska, and the master was taken to Anchorage for the hearing. Following the legal action, the Japanese captain returned to Kodiak. His vessel was released and departed for open waters on the evening of March 28.

An NMFS spokesman said that previously the highest penalty ever assessed against a foreign vessel and its master for illegal fishing operations in U.S. waters was $250,000 levied against a Soviet trawler fishing off Alaska in February 1974.

## Sea Variables Tested With Lab-Reared Fish

Amid the glassware, particle counters, microscopes, and sampling nets loaded aboard the National Oceanic and Atmospheric Administration's (NOAA) research vessel, *David Starr Jordan*, as it prepared to leave San Diego for a one-week cruise off southern California recently was an unusual cargo. Carefully carried aboard ship were numerous glass beakers filled with sea water and tiny (less than 5 mm) anchovy larvae spawned in the experimental aquarium at NOAA's National Marine Fisheries Service laboratory in La Jolla, California. With this fisheries equivalent of carrying coals to Newcastle, Dr. Reuben Lasker, a physiologist at the La Jolla facility, hoped to test his idea that laboratory-reared anchovy could be used in lieu of naturally-spawned larvae as an assay of conditions in the sea.

Dr. Lasker explained that this rare experiment may help to answer what is perhaps the most important and fundamental question in fisheries: What is the basic cause and effect mechanism(s) which determines how many young fish will survive the rigors of life in the sea to become reproducing adults? On the answer to this question may rest the ability of fishery biologists to predict the success of each year's brood of fish and ultimately how many tons of fish can be harvested by fishermen without endangering fish stocks. According to Dr. Lasker, food abundance may be the key to survival. Fishery biologists have known for some time that, on the average, there is not enough food available in the sea for fish larvae and have theorized that this scarcity of food may be an important cause of the large mortalities that occur at this early life stage of fishes.

The development of the anchovy larvae that Dr. Lasker took with him on the *Jordan* was controlled in the laboratory by manipulating temperatures so that all the fish would be at the first-feeding stage. Dr. Lasker intended to place the small fish in samples of sea water to find out with certainty whether there is sufficient natural food present in specific coastal areas of the ocean for larvae entering the independent feeding stage to survive.

Assisted by Ms. Eileen Setzler of the University of Georgia and Dr. Dale Kiefer of the Food Chain Research Group at the Scripps Institution of Oceanography, La Jolla, California, Dr. Lasker tested the surface water off southern California at a number of places with disappointing results. Finally, sampling instruments encountered an extensive layer or band of abundant green plant material at a depth of approximately 15 meters at five locations from Malibu to San Onofre, California. Anchovy larvae placed in these samples of sea water which contained high concentrations (40 to 400 cells per milliliter) of the dinoflagellate, *Gymnodinium splendens*, fed actively upon the tiny organism. At the higher concentrations some larvae filled their straight guts in a few hours, a result seen only before in laboratory experiments. Coincidentally, said Dr. Lasker *G. splendens* is

the same organism which was found earlier to support growth of anchovy larvae in laboratory-rearing experiments.

Dr. Lasker said these shipboard experiments confirmed earlier findings in the laboratory which had demonstrated that high concentrations of food organisms are needed for continued growth and survival of anchovy larvae. It was also demonstrated that there are large patches containing high numbers of *Gymnodinium* in long bands along the southern California coast at a depth of 15-20 m during the natural anchovy spawning season in the area.

Using a 16-channel particle-sizing and counting instrument, Dr. Lasker and his colleagues were able to show that feeding by anchovy larvae only took place when algal cells of 0.04 millimeters and larger were present (particularly *Gymnodinium*). Smaller particles, even though present in large numbers, did not stimulate feeding in anchovy larvae.

In commenting on this experiment, Dr. Brian J. Rothschild, Director of the NMFS Southwest Fisheries Center which is headquartered in La Jolla, said he believed Dr. Lasker's work was a breakthrough in fishery biology and showed conclusively that laboratory-reared anchovy spontaneously adapt to natural food, and the coastal waters explored by Dr. Lasker provide sufficient food for the survival of fish larvae over an extensive area, particularly during the spring when anchovy spawning occurs naturally in the ocean.

## *Cash For Tuna Tags*

A French fisherman working on the Ivory Coast tuna seiner, *Trident*, and the captain and crew of the U.S. tuna seiner, *A.A. Ferrante* from Massachusetts, each won $300 for their recovered tuna tags in the lottery for 1973 tag recoveries held by the International Commission for the Conservation of Atlantic Tunas (ICCAT) in Madrid, Spain on March 15, 1974, according to information received by Dr. Gary Sakagawa, fishery biologist at the National Marine Fisheries Service Southwest Fisheries Center laboratory in La Jolla, California and U.S. tagging correspondent for ICCAT.

The purpose of the lottery, which is held annually, is to encourage persons recovering tags attached to tuna fish by scientists during tagging cruises or sport fishermen cooperating in marine game fish tagging programs to return these tags to the appropriate agency.

Winning tag TO4582 was recovered from one of 2,157 tuna fish tagged and released by ORSTOM, a French research organization, Pointe Noire, Congo, in 1973. This particular fish, a bigeye tuna, was repeased in the Gulf of Guinea on June 26, 1973. It was recaptured only four days later on June 30, 1973, at the same location, by Mr. Albert Marec on the *Trident*.

Winning tag 035819 was attached to a bluefin tuna by scientists from the Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, on September 6, 1972 off NE United States and was recovered 322 days later by the crew of the *A.A. Ferrante* on July 25 1973. During almost a year of freedom the fish had grown 12.4 cm.

Dr. Sakagawa explained that ICCAT was founded in 1969 on the basis of an international convention with the objective of maintaining the tuna stocks in the Atlantic Ocean at levels that will permit maximum utilization. The United States is one of 13 member countries participating in ICCAT. In order to achieve its objectives, the Commission conducts extensive joint international research on tunas. The tagging experiment is one of its most important research techniques since the tags recovered provide information on tuna population structures, area of distribution, migratory patterns, growth rates, and mortality rates, etc. Information from these tagging projects is also important to fishermen since it permits them to plan their activities better and to determine the most efficient fishing methods, grounds and seasons.

For the past three years, the ICCAT member countries have conducted joint tagging experiments in the Atlantic Ocean. In these experiments, scientists on board research ships catch tuna alive, attach tags to their backs and return fish to the ocean. The tags are small yellow tubes with dart heads, and carry identification numbers and a forwarding address. A reward is paid for each tag returned and these tags are later entered in the ICCAT annual tag recovery lottery.

Dr. Sakagawa urged commercial and sport fishermen, cannery workers, and others who may handle tuna to cooperate in ICCAT's tuna tagging program and to report all tags promptly.

## NOAA Announces More CZ Grants

Secretary of Commerce Frederick B. Dent has announced the award of $1,152,050 in grants to California, Michigan, and Mississippi, to assist the three states in developing programs to manage their coastal lands and adjoining waters.

The grants are made by the National Oceanic and Atmospheric Administration as part of its responsibilities under the Coastal Zone Management Act of 1972, to encourage effective management, beneficial use, protection and development along America's sea coasts and Great Lakes shores.

The grants made available $720,000 to California, $330,486 to Michigan, and $101,564 to Mississippi. Each state is contributing a matching share of the coastal zone management funds, which by law must amount to at least one-third of the total program cost. The first three grants in this program were made March 14 to Rhode Island, Maine, and Oregon.

The NOAA grant to Mississippi will be administered by the Mississippi Marine Resources Council, as designated by Gov. William L. Waller. The Council will coordinate the contributions of 17 state agencies, offices, and local organizations during the preparation of the management program, which is designed to produce an approvable program in three years. The first year's work will concentrate on identifying all the state activities and agencies bearing on the coastal zone, achieving full coordination of activities at the local and regional levels, and obtaining and evaluating the data necessary to develop a coastal zone management program. The Council is considering allocating portions of the grant to the Mississippi-Alabama Sea Grant Con-

sortium, the Southern Mississippi Planning and Development District, and the Gulf Regional Planning Commission for assistance in carrying out the work program.

The California grant will be administered by the California Coastal Zone Conservation Commission (CCZCC), which was designated by Governor Ronald Reagan as the applicant agency. The CCZCC, which comprises one State and six regional commissions, was created by the California Coastal Zone Conservation Act of 1972, and the commission is required to adopt by Dec. 1, 1975, a comprehensive plan for the long-range conservation and use of California's coastal zone resources. While the planning program—which must be submitted to the state legislature—is under way, the CCZCC has regulated development along the coastline through a permit system.

California's one-year work program involves five State departments, two universities, and seven other commissions and councils. It is designed to take into account the needs of coastal land environment, energy, recreation, design, transportation, geology (including non-petroleum minerals), and the marine environment. Work previously carried on by the state's two Sea Grant programs will also be utilized.

The grant to Michigan will be administered by the State's Department of Natural Resources, as designated by Gov. William G. Milliken. The first "inland" state to be awarded a coastal zone grant, Michigan will use the initial funds in a two-year project to formulate a comprehensive program for the management of the state's Great Lakes shorelands. Among the studies planned to assist in the creation of this management program are those involving the definition of the shoreland zone boundary, an inventory of lake use, ownership, and other characteristics, a practical data management system, a navigation needs study, and the involvement of regional planning agencies.

## NOAA, Woods Hole Cooperate in Program To Tag and Track Atlantic Ocean Game Fish

Tagging of large Atlantic game fish for scientific study is now the dual responsibility of the Woods Hole Oceanographic Institution and the Commerce Department's National Oceanic and Atmospheric Administration.

The 20-year-old Cooperative Game Fish Tagging Program, pioneered in the Atlantic by the Cape Cod institution, was restructured in 1973 as a cooperative effort to be shared by private scientists and Federal investigators stationed at NOAA's National Marine Fisheries Service Southeast Fisheries Center, Miami, Florida.

Information collected through gamefish tagging programs is important to the study and evaluation of the life cycles of large, wide-ranging species, and eventually is translated into scientific recommendations for the rational management and conservation of a valuable natural resource. Tagging data also are useful to sport and commercial fisheries and to economic planners in coastal regions.

Marlins, sailfish, tunas, and other highly valued game fish have figured prominently in tagging studies undertaken since the early 1950's by the Cooperative Game Fish Tagging Program, and a significant body of information now exists concerning their biology, ecology, population dynamics, and migratory habits. Thousands of these fish have been tagged and released, and many have been recaptured over two decades of voluntary participation by Atlantic anglers and marine researchers, with the support of sport and scientific organizations. These include the Sport Fishing Institute, NOAA's Office of Sea Grant, the National Science Foundation, and the Bureau of Commercial Fisheries (which became the NMFS in 1970).

Recaptured tags, returned to project scientists from fishermen in widely separated regions, have made possible analyses of the migratory routes followed by many prized and hotly pursued sport and food fish. Findings reveal, for instance, that certain stocks of white marlin apparently spend the winter off the northern coast of South America, then migrate to the mid-Atlantic coast of the United States in summer and early fall. Another group appears to spend the summer in the northern Gulf of Mexico. Giant bluefin tunas tagged off the northeastern United States and recaptured off Norway provide documentation of transatlantic migrations by the species. Data from tagging studies also imply that fishing pressure on the bluefin tuna is heavy.

Some of the data obtained through tagging programs has gained significance in recent years as nationally renowned conservationists, sportsmen, and scientists have expressed increasing concern over the status of the tuna and billfish populations. The subject also was the focus of attention at an international conservation meeting held last year when the United States formally expressed its concern for northern bluefin tuna stocks of the Atlantic Ocean at the annual meeting of the 13-member International Commission for the Conservation of Atlantic Tunas. Cited as the reason for concern were indications of decreases in abundance of the wide-ranging tuna, as partially indicated by tag returns.

Frank J. Mather III, the Woods Hole biologist and internationally known sport fisherman who originated and managed the tagging program from its inception, continued in 1973-1974 to coordinate and direct tagging activities, from Miami (winter) and Woods Hole (summer). The present division of work between the northeast and southeast Atlantic is a natural consequence of both a geographical expansion of Mr. Mather's work and a substantial increase in the NOAA-NMFS involvement in game-fish investigations.

The cooperative program will be integrated with the Oceanic Game Fish Investigation program, in operation at the NMFS Southeast Fisheries Center for more than two years under the direction of biologist-sport fisherman Dr. Grant L. Beardsley. Fisheries scientists in the program collect catch and fishing statistics from big-game fishing tournaments throughout the western North Atlantic, Caribbean Sea, and Gulf of Mexico.

# Baltic Sea Environmental Pact Is Signed

An anti-pollution convention among the seven countries bordering on the Baltic Sea was signed in Helsinki, Finland on 22 March 1974. Representatives from the USSR, Poland, the Federal Republic of Germany, Denmark, Sweden, Finland, and East Germany also agreed to establish a Commission which will enforce the anti-pollution regulations provided by the Convention. The Commission will be headquartered in Helsinki; its personnel will be drawn from the countries participating in drafting the Convention. Pollution in the Baltic is caused by agricultural chemicals, industrial and urban wastes, and discharges from vessels.

The agricultural pollutants are mostly pesticides and fertilizers washed into the sea from the fields. The excess phosphorus from fertilizers (as well as from detergents and industrial wastes) encourages the growth of marine plants, which consume large quantities of oxygen, deprive other marine organisms of this essential element, and become a pollutant themselves.

Mercury from paper factories is most noted among the industrial pollutants. This metal, along with agricultural pesticides, accumulates in all marine organisms. Some Baltic grounds have been closed to fishing because the catch from these areas had too high a concentration of chemicals to be marketable. In addition the cities surrounding the Baltic have been discharging largely untreated sewage into the sea.

Merchant, fishing, and pleasure craft clean out their hulls and discharge human and fish-processing wastes and garbage directly into the water.

The Baltic's geography aggravates the pollution. Being almost completely enclosed by land, the Baltic receives limited infusions of cleaner waters from the Atlantic Ocean. In such naturally stagnant water, the pollutants accumulate.

The new Convention forbids the dumping of solid wastes and of chemicals into the Baltic, and provides for the construction of sewage treatment facilities. The Baltic Sea Commission will enforce these regulations and will develop further measures, which, in addition to already existing laws, will hopefully prevent an early "death" of the Baltic Sea.

The Convention signed in Helsinki is one of the few agreements dealing with the comprehensive ecological protection of a major body of water, according to the NMFS's office of International Activities. Additional data on the background events leading to the Helsinki Conference are available from the office of International Fisheries (Att: M. Kravanja).

## Peruvian Anchovy Fishing Continues

Peruvian anchovy fishing was continuing in May with the catch averaging nearly 60,000 metric tons daily. Reports indicate that fishing grounds along the northern coast are recovering, and fishing is generally good in all areas. Peruvian officials have announced their intention to continue fishing until a two million ton catch is reached for the first period of 1974. Following a closed period, fishing is expected to resume in September or October with the total catch for 1974 reaching 3.5 million tons. (As of April 26 approximately 1.6 million metric tons had been taken.)

*Pesca Peru* reports that fish meal recovery is at 22 percent and fish oil is averaging 6 percent. (Fish meal recovery during 1974 has ranged between 21.9 percent and 23.8 percent.) Hoping to produce around 1 million tons of fish meal, Peru anticipates exports of up to 180,000 tons; however, meal sales thus far have been slow. Although EPCHAP is currently asking $420 or more FOB Peru per metric ton for fish meal, purchasing offers are in the area of $350. Apparently, fish oil is being marketed with sales to Colombia reported at $500 per metric ton. Current conditions indicate that Peru could sell 40-50 thousand tons of fish oil during the first half of 1974 after fulfilling its domestic needs.

## *Taiwan Predicts Fish Production Increase*

Taiwan will produce 820,000 metric tons of fish in 1974, an increase of 60,000 metric tons or nearly 8 percent over last year, according to a Taiwan Fisheries Bureau report in the *China Post*. Deep-sea fishing will total 405,000 metric tons in 1974, the Bureau predicted. Offshore fishing will contribute 280,000 tons, fish culture will yield 105,000 tons, and coastal catch will provide 30,000 tons.

## *Soviets, East Germans Develop Echosounder*

Soviet and East German fishery scientists will test a Soviet-made device for hydroacoustic assessment of commercial fish stocks. The device, constructed by the engineers of the Polar Scientific Research Institute for Marine Fisheries and Oceanography (PINRO) will be mounted on a PINRO research vessel, the *Poisk*, and on a research vessel belonging to the G.D.R. Marine Fisheries Institute, the *Eisbaer*, which has come to Murmansk, the headquarters of PINRO. The two vessels will then make a joint research trip to obtain comparative results.

According to the Office of International Fisheries, NMFS, the research medium trawler *Poisk* was built at Volgograd Shipyards in 1971 especially for PINRO. The vessel belongs to the so-called "Maiak" class of medium refrigerated trawlers (SRTMs) of 700 GRT and a crew of about 30; it is currently attached to the Murmansk Exploratory Fleet. The Soviets say the *Poisk* was built specifically for hydroacoustic research work. It is not clear exactly what is meant by this phrase, except that the vessel may have some built-in sonar domes or (if the Soviet scientists are using hydrophones in connection with echosounder research) that its engines are quieter than those on other SRTMs. Soviet sources do not give the name of the hydroacoustic device they are using. The Soviet Ministry of Fisheries has, during the past decade, developed more than a dozen echosounders; the Murmansk Herring Fleet uses one of these for deep-water (500-600 fathoms) hydroacoustic research.

*Fishery Notes*

## New Fishery Role for University of Alaska

The University of Alaska will be thrust into the mainstream of Alaska's fishery industry and programs if the plans of a new fishery group are successful, reports the Alaska Department of Fish & Game. At an organizational meeting held in Juneau in April, Dr. Robert W. Hiatt, President of the University; Harry L. Rietze, Alaska Director of the National Marine Fisheries Service; and James W. Brooks, Commissioner of the Department of Fish and Game, agreed on the need for enlarging the role of the University both in fishery education and in supporting research and investigations as a foundation for managing Alaska's fishery resources. The necessary planning and coordination will be achieved through an Alaska Interagency Fisheries Committee composed of the President of the University and the heads of federal and state fishery agencies. The committee members agreed to increase membership to include a member of the Alaska Legislature and a representative of the Office of the Governor.

Dr. Hiatt, a prominent fishery scientist as well as educator, stated that the University should assume more responsibility for furnishing short term services to the fishing community through specialized vocational programs, as well as long term contributions by training young scientists in Alaska and doing research in critical areas that could lead to vastly im-improved production of fishery resources.

The committee will meet twice a year to assure interagency coordination, with emphasis on establishing priorities, defining roles, and assessing financial and personnel resources available or required to meet essential fishery program objectives.

## In Brief . . .

. . . **"National Needs and Ocean Solutions"** headlines the 10th annual Marine Technology Society conference and exposition in Washington, D.C., Sept. 23-25. Annual MTS awards, a film festival, and a university-sponsored short course are included. For more information contact MTS at 1730 M St., N.W., Washington, DC 20036 . . .

. . . **Two artificial fishing reefs** are planned by North and South Carolina 2½ and 5½ miles off their boundary to increase fishing potential, according to a report in *The Marine Newsletter*. The joint effort will employ scrap tires, concrete units, steel ship hulls . . .

. . . Sportfisherman Tom Gibson needed 30 minutes to land **Texas' new 210-pound record tarpon**—a 7-foot, 2¼-incher, 45¼ inches in girth. Taken drift fishing out of Port Isabel on 100-pound test line, the fish is also an International Game Fish Association record for its class, according to the Texas Parks and Wildlife Commission . . .

. . . **A two-year expansion program,** included three major new buildings costing over $4.5 million, is set for South Carolina's Marine Resources Center at Ft. Johnson, near Charleston, according to *The Marine Newsletter*. State bonds will fund the expansion, and NMFS is expected to lease a new seafood technology center there . . .

. . . A new 32½ × 3½ × 4-inch, 8-ounce, expanded **polystyrene live-eel shipping box** has been developed for the growing U.S. eel export business. The ventilated, slide-topped box holds 4 pounds of eels and a chunk of ice supplies fresh, cool water. More information is available from NMFS Market New Report issuing offices . . .

. . . **The Sixth International Conference on Underwater Education** (IQ6) will be held in San Diego, Calif., Oct. 4-6, by the National Association of Underwater Instructors. Programs spotlight diving frontiers, the state of the art, underwater gear . . .

. . . Though **Alaska's long-range salmon enhancement program** had more than 4 million fish and eggs in its propagation systems last winter, Fish and Game Department biologists consider that it may still be "several years" before full impact is seen . . .

. . . **U.S. shrimpers took a record** million-pounds-plus of rock shrimp, primarily from the Contoy (Bay of Campeche, Mexico) grounds, last year, according to NMFS data. Rock shrimp are widely distributed in the Gulf and off the east coast of Florida, and can be fished between other shrimp seasons . . .

. . . **The 25th Tuna Conference,** a forum for informal discussions of ongoing tuna research problems, is scheduled for Sept. 29-Oct. 2 at the University of California Conference Center, Lake Arrowhead, Calif. . . .

. . . Realignment of **California's ocean-oriented resource programs** has placed marine resources management and law enforcement functions under the Department of Fish and Game's Marine Resources Region in Long Beach. All ocean-related research projects were regrouped under the DFG's Operations Research Branch in Sacramento. Changes were effective May 1, reports *Outdoor California*, the department's bi-monthly magazine . . .

. . . New chairman of ICCAT's (International Commission for the Conservation of Atlantic Tuna) Standing Committee for Research and Statistics is **Dr. Brian J. Rothschild,** Director of NMFS's Southwest Fisheries Center. SCRS advises the Commission on tuna status with regard to fishing levels and makes conservation recommendations . . .

. . . **Redefinition of the Bering Sea commercial shellfish area** by Alaska's Board of Fish and Game now includes all waters of the Bering and Chukchi Seas north of the latitude of Cape Sarichef. The action, according to DFG sources, was designed to simplify management of king crab stocks in the area and to aid in managing the developing Bering Sea fishery . . .

. . . **An apparent 20-year decline in California's spiny lobster** (*Panulirus interruptus*) has spurred a new research program according to *Outdoor California*. Items studied will include: present commercial and sport lobster fisheries; life history and population structure data; fishing gear; predation by fish; and mortality from discarded traps. Closed season fishing and taking undersize lobsters are two of the more obvious inimical factors according to biologists . . .

*Publications*

# New Foreign Fishery Translations

A limited number of the following Russian, Polish, and Yugoslav publications translated and printed for the National Marine Fisheries Service (NMFS) under the Special Foreign Currency Program (financed with Public Law 480 funds) are available for free distribution from the Translation Program, Office of International Fisheries, F41, NMFS, NOAA, U.S. Department of Commerce, Washington, D.C. 20235. Please request by translation (TT) number.

Translation numbers, titles, and authors include: TT 67-51202, Helminthofauna of marine mammals, Delyamure, S.L.; TT 67-51265, Search for fish with hydroacoustical apparatus, Azhazha, V.G., and E.V. Shishkova; TT 67-58026, Observations on the behavior of sardine under artificial light, Grubisic, F.; TT 67-58028, Bass, Basioli, J.; TT 67-58030, The shark and man, Radovanic, R.; TT 67-59063, Biological and oceanographic conditions for formation of commercial concentrations of fish, Moiseev, P.A. (Editor); TT 68-50361, Fishes of the Sea of Japan and the adjacent areas of the Sea of Okhotsk and Yellow Sea. Part 2, Teleostomi. XII. Acipenseriformes - XXVIII. Polynemiformes, Lindberg, G.U., and M.I. Legeza; TT 69-55063, Methods of assessing fish resources and forecasting catches, Dement'eva, T.F., and K.A. Zemskaia; TT 69-55064, Elementary populations of fish, Lebedev, N.V.; TT 70-55126/1,2, Shipbuilding, Vol. 15, Nos. 1,2, 1970; TT 70-55126/7,8, Shipbuilding, Vol. 15, Nos. 7,8; TT 70-55126/9,10, Shipbuilding, Vol. 15, Nos. 9,10, 1970; TT 70-55125/1,2, Marine Technology and Management, Vol. 20, Nos. 1,2; TT 70-55125/5,6, Marine Technology and Management, Vol. 20, Nos. 5,6; TT 70-55125/10, 11, Marine Technology and Management, Vol. 20, Nos. 10-11, 1970.

**Chydoridae,** by N.N. Smirnov, "Fauna of the U.S.S.R.," New Series No. 101, "Crustacea," Vol. 1, No. 2, Zoological Institute, Academy of Sciences of the U.S.S.R., Leningrad, 1971, 644 p., 658 figs. This is a comprehensive revision of the classification of Chydoridae (the largest family of the order Cladocera) on the basis of new data, examination of types, and review of existing literature. In addition to intensive sampling within the U.S.S.R., the author examined numerous samples and other material supplied by researchers around the world. In reclassification, the author has attempted to make keys applicable over a broader geographical area, to rationalize multiple classifications, and to supply useful information on internal morphology and function.

Analysis was carried out mainly from 1959 to 1966 at the Zooplankton and Zoobenthos Laboratory of the Institute of Inland Water Biology of the Academy of Sciences of the USSR and completed at the Institute of Evolutional Morphology and Ecology of the Academy. The translation was produced by the Israel Program for Scientific Translations under the auspices of the U.S.-Israel Binational Science Foundation; it was published in 1974. It is available from Halstead Press, 605 Third Avenue, N.Y., NY 10016 or from Keter Publishing House Ltd., P.O.B. 7145, Jerusalem, Israel, price $42.00.

## *A Russian-English Fisheries Dictionary*

Published by the Fisheries Research Board of Canada (FRBC), the **Russian-English Dictionary of Fisheries and Aquatic Biology** contains about 11,000 terms of which half are names of fishes, with emphasis on the fauna of the USSR and on commercial fishes of the rest of the world. Names of aquatic organisms and marine mammals are included. Also covered are terms for fishing gear and fishing vessels, fishery products, as well as fish processing, morphology, physiology, ecology and population dynamics, and the names of common fish diseases. The dictionary contains an index of the English and scientific names of all the organisms and of other words used in the definitions.

The dictionary's author, Dr. W.E. Ricker, retired recently as Chief Scientist, FRBC. He was Interim Chairman of the FRBC from 1963 to 1964 and has held other important senior positions. His major contributions have been in the dynamics of fish populations and Pacific salmon biology. The dictionary was published as FRBC Bulletin No. 183. It is available from Information, Ottawa, Canada K1A 0S9, for Canadian $8.40 per copy. Advance payment by postal money order or personal check is required in the equivalent of the dictionary's cost in Canadian currency, payable to the Receiver General of Canada.

## Fisheries Resource Maps

**Distribution of Fish Eggs and Larvae in Continental Shelf Waters, Nova Scotia to Long Island,** Folio 23. John B. Colton, Jr. and Jeanne M. St. Onge, National Marine Fisheries Service, Narragansett Laboratory, Narragansett, RI 02882.

This folio summarizes by month the distribution of the common planktonic fish eggs and larvae in continental shelf waters between Cape Sable and Long Island. The collections forming the basis for compiling the maps were obtained on 45 cruises conducted from 1953 to 1971 by the Bureau of Commercial Fisheries (now the National Marine Fisheries Service), the Fisheries Research Board of Canada, and the Ministry for Food, Agriculture, and Forestry of the Federal Republic of Germany. There are eleven plates in the folio. Two depict cruise tracks and collection locations, two show egg distribution, and seven contain the maps of larvae distribution. A single plate consists of twelve maps in most cases. Twelve fish species are represented on the egg-distribution maps and 28 species on the larvae distributions. Copies are available from the National Marine Fisheries Service or the American Geographical Society, Broadway at 156th St., New York, NY 10032.

## *World Fisheries Research Issues*

**Socio-Economic Research Issues in Fisheries Development,** a 12-page technical report from the International Center for Marine Resource Development at the University of Rhode Island, examines worldwide development of fisheries resources. Noting that information on fishing and fishermen in the developing countries is scarce, the report cites issues that seem critical at this time. The booklet, P-319, is available free of charge from the URI Marine Advisory Service, Narragansett, RI 02882.

# Comparisons

• T. S. Sealy's detailed analysis of the fishing fleet of the USSR in this month's number of *Marine Fisheries Review* provides a basis for some interesting comparisons with the United States.

He gives the 1971 USSR catch as 7,336,700 metric tons. According to *Fisheries of the United States, 1973*, Current Fisheries Statistics No. 6400, the U.S. catch in 1971 was 2,793,000 metric tons, a little more than one-third of the USSR catch.

Sealy gives the total number of Soviet fishing vessels of more than 100 gross registered tons as 3,247 in 1971. According to the NMFS Office of Statistics and Market News, which is now preparing the detailed breakdown on fishery statistics of 1971, the comparable U.S. figure is 1,018.

Probably the most interesting statistic Sealy presents is that for the role played by fish in the animal protein diet of the USSR: a whopping 30 percent. A comparable figure for the United States is not easy to come by. However, a publication of the Agricultural Research Service has some interesting figures. The publication is *Food Intake and Nutritive Value of Diets of Men, Women, and Children in the United States, Spring 1965, A Preliminary Report*, ARS 62-18, March 1969. John Dassow of the NMFS Pacific Fishery Products Technology Laboratory points out that Table 12 (page 82) shows that for all income groups, males of 35-54 years obtained 56.1 percent of their protein from meat, poultry, and fish. (The percentages were above 50 percent for all the adult groups.) Table 4a, page 39, discloses that males of this same age group averaged 301 grams of meat, poultry, and fish. Of this amount, 13 grams consisted of fish and shellfish. This is 4 percent of the total. Multiplying by 56 percent mentioned earlier, one arrives at about 2 percent of the animal protein diet being supplied by fish. Thus the Soviet requirement for fish would be about 15 times our own.

• The islands of the West Indies (excluding Cuba) constitute a combined land area of about the size of the State of Maine and populated by more than 10 million people. Coming up for publication in *Marine Fisheries Review* in September is a special number dealing with the studies on the fisheries of the region conducted there several years ago under the auspices of the United Nations Food and Agriculture Organization. Only one aspect of this large-scale project has been the subject of a formal publication before. This "Caribbean number" of *Marine Fisheries Review* will thus provide a permanent record of the remainder of these basic investigations.

The papers are:

"A summary of exploratory fishing activities of the UNDP/FAO Caribbean Fishery Development Project" by Robert S. Wolf and Warren F. Rathjen.

"Headline and longline fishing explorations for snapper and related species in the Caribbean and adjacent waters," by Kuotaro Kawaguchi.

"Results of live bait and pole and line fishing explorations for pelagic fishes in the Caribbean," by Donald P. Wagner.

"Results of trolling fishing explorations in the Caribbean," by Donald P. Wagner and Robert S. Wolf.

"Spiny lobster fishing explorations in the Caribbean," by Geoffrey R. Chislett and Misuo Yesaki.

"Trap fishing explorations for snapper and related species in the Caribbean and adjacent waters," by Robert S. Wolf and Geoffrey R. Chislett.

"Exploratory tuna longline fishing in the Caribbean and adjacent waters," by Kyotaro Kawaguchi.

"Results of experimental and exploratory shark fishing off northeastern South America," by L. J. K. Kleijn.

"Minor exploratory fishing activities in the Caribbean and adjacent waters," by Robert S. Wolf.

• Also scheduled for publication, probably in August, is what, around the office, we have taken to calling "Billfish Two." This is verbal shorthand for the second volume of the proceedings of the Billfish Symposium held in Hawaii in 1972. "Billfish Two" contains the review papers and contributed papers and will appear as NOAA Technical Report NMFS SSRF-675. "Billfish Two" carries 38 scientific papers about billfishes and runs to a massive 335 pages. Meanwhile, part of the manuscript of "Billfish Three" has turned up for processing. This third volume (which will be shorter) will carry species synopses of the world's billfishes. These volumes will constitute invaluable aids to marine scientists and to administrators: they will probably also appeal to a number of the world's big game fishermen.

You may be wondering what "Billfish One" may be. It will consist of an account of the Billfish Symposium itself, and in accord with a logically exasperating but time honored tradition of scientific publishing, will be the last to appear.

• We recently checked out, for the Director's Office, the list of publications by NMFS authors that was to appear in the *Report of the National Marine Fisheries Service for Calendar Year 1973*.

There were almost 500 publications, a high number for a staff the size of that of NMFS. Of those, 61 or 12.5 percent, appeared in *Marine Fisheries Review*, as contrasted with 5.4 percent in 1972, or, from an earlier time, 6.4 percent in 1968. The 61 papers in 1973 constituted over three times the number printed in 1972.

• If you think this month's number of *Marine Fisheries Review* looks a little different—it does. We hope you will find nothing less legible and even that the appearance of some of the pages will be improved.

• Recently we learned that the Superintendent of Documents has upped his order of copies of *Marine Fisheries Review* by 30 percent. This is gratifying news: we hope to make the publication sufficiently worthwhile to its recipients so that they do not feel let down.

T.A.M.



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